Charles University in Prague
Faculty of Social Sciences
Institute of Economic Studies

Master thesis

Impact of pension reform to implicit pension debt: Evidence of pension reforms in EU in 1993-2013

Author: **Josef Obořil**

Supervisor: **doc. MPhil. Ondřej Schneider Ph.D.**

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Declaration of Authorship

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Signature

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Abstract

This thesis investigates impact of pension reforms implemented in the EU27 countries in time period 1993 - 2013 to implicit pension debt. We applied Holzmann's (2004) methodology to calculate implicit pension debt. Primary outcome is that in the investigated period, 21 countries have reduced its implicit pension debt in range of 57% to 700% of its GDP. On the other side, in Denmark, Germany and Portugal, implicit pension debt increased in range 10% - 194% of their GDP.

Paper also investigated impact of individual components implemented in pension reforms. Largest impact was recorded by change of pension age. Increasing pension age by 1 year reduced the IPD by 46% of GDP on EU27 level. This was also the most often used measure as it was implemented 42 times in the investigated period. Reforms of indexation have also significant impact on IPD, however, as indexation is linked to chosen variables to decrease IPD it is only possible to change indexation linkage. Possibilities of early retirement were also limited, as it was adjusted 13 times. The effect was smaller in comparison to increasing retirement age where increasing early retirement age decreased implicit pension debt by 21% of GDP on the EU27 level. This equals to impact of increasing contribution rate by 1 p.p. The smallest impact was recorded by decreasing replacement rate by 1 p.p. which reduced IPD by 16% of GDP on EU27 level.

Keywords

Pension reform, Implicit debt, European Union

JEL Classification

H55, I39, J11

Abstrakt

Tato diplomová práce zkoumá dopad penzijních reforem zavedených ve státech EU27 v období 1993 - 2013 na implicitní penzijní dluh. Použili jsme Holzmannnovu (2004) metodologii k výpočtu implicitního penzijního dluhu. Ve zkoumaném období snížilo 21 států svoje implicitní penzijní dluhy v rozsahu od 57% do 700% HDP. Na druhé straně, Dánsko, Německo a Portugalsko své implicitní penzijní dluhy zvýšilo o 10% - 194% jejich HDP.

Diplomová práce také zkoumá dopad jednotlivých komponentů penzijních reforem. Největší dopad byl zaznamenán změnou penzijního věku. Zvýšení penzijního věku o 1 rok sníží implicitní penzijní dluh o 46% HDP na úrovni států EU27. Toto opatření bylo také nejčastěji zaváděným, jelikož bylo použito 42 - krát ve zkoumaném období. Změny indexace měly také signifikantní dopad na implicitní dluh. Nicméně, jelikož je indexace vázána na určenou makroekonomickou proměnnou, pro snížení dluhu je možné pouze změnit tuto závislost na jinou proměnnou. Možnosti předčasného důchodu byly také omezovány; v letech 1993 - 2013 tak bylo celkem učiněno 13 - krát. Efekt na implicitní penzijní dluh byl menší v porovnání se zvyšováním důchodového věku; zvýšení věku pro předčasný důchod zredukovalo penzijní dluh o 21% HDP na agregované úrovni států EU27. Stejný dopad mělo i zvýšení sazby odvodů na starobní důchody o 1 procentní bod. Nejmenší dopad, 16% HDP za stejných podmínek jako v předchozích případech, bylo dosaženo snížením náhradového poměru o 1 procentní bod.

Klíčová slova

Penzijní reforma, Implicitní dluh, Evropská unie

Klasifikace JEL

H55, I39, J11

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Abbreviations

General abbreviations

CR Contribution rate

DB Defined benefit

DC Defined contribution

ERA Early retirement age

EU European Union

F Females

ILO International labour organization

IN Indexation

IPD Implicit pension debt

M Males

NDC Notional defined contribution

PAYG Pay-As-You-Go

RA Retirement age

RR Replacement rate

Countries abbreviations

AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czech Republic
DK	Denmark
EE	Estonia
FI	Finland
FR	France
DE	Germany
EL	Greece
HU	Hungary
IE	Ireland
IT	Italy
LV	Latvia
LT	Lithuania
LU	Luxembourg
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SK	Slovakia
SI	Slovenia
ES	Spain
SE	Sweden
UK	United Kingdom
EU27	European Union comprising 27 countries

Diploma Thesis Proposal

Author	Josef Obořil
Supervisor	doc. MPhil. Ondřej Schneider Ph.D.
Proposed topic	Impact of pension reform to implicit pension debt: Evidence of pension reforms in EU in 1993-2013

Topic characteristics and methodology

Ageing population, higher life expectancy, and lower birthrate are currently testing pension systems in the whole Europe. Past pension systems had not been satisfactory for these changes; the intergenerational redistribution was high, young people paid the old people much more than they will get back, liabilities of governments to retirees (so called "implicit pension debt") grew by fast pace. From these reasons, reforms of pension systems occurred in many countries, which are implemented from 90's of 20th century till now throughout the Europe. These pension reforms, despite its similar forms, use slightly different measures - rising the retirement age, introduction of second and third pillar of pension saving. The main goal of these reforms was lowering implicit pension debts and improvement the intergenerational redistribution of money. This raises the question: What is the impact of these reforms to implicit pension debt? What impact do the individual measures have? Is the redistribution of money more acceptable after the reform? How much it helped? By solving these questions, we will see the final impacts of the reforms and moreover we will be able to compare the resulting impact among countries and derive its common implications. In literature, these questions were already investigated in some countries (e.g. Poland, Romania, Hungary) in the past, however a complex analysis if reform impacts is still missing.

Starting with description of implemented reforms, their common concepts, and peculiarities among countries, we will get to concept of implicit pension debt and its calculation before and after reforms. Further, we will also estimate intergenerational redistribution before and after crisis. The results can be further compared among countries and possible implications will be made. In the end, we will also try to

eliminate impact of individual measures on the total impact of a pension reform. The calculations will be held according to approach based on previous literature. Namely, we will compute implicit pension debt as a sum of discounted cash flows of future pension system incomes and expenses based on population projections and average income of age cohort of inhabitants. For the calculation two types of data will be needed: population projections and average income according to age cohort of inhabitants. The projections are available in Ageing report 2012 published by European union. The average incomes are published by Eurostat.

Hypotheses

1. Implicit pension debts were lower after performing a pension system reform.
2. Intergenerational redistribution is more balanced after the reform
3. People get in average smaller old-age pension after the reform than before the reform.

Outline

1. Introduction
2. Introduction of reforms
3. Literature review
4. Methodology
5. Data
6. Empirical results
7. Conclusion

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Author Supervisor

Chapter 1

Introduction

Pension systems in the European Union (EU) are facing a big challenge in these days. The world wars during previous century changed deeply the structure of population and average age was decreasing. After the world wars an opposite effect could be seen. The population started to flourish, higher standards of living in combination with safer environment increased birth rate which was later reflected in a fact that high number of children outweighed the number of pensioners. Pension systems in many countries were adapted to this trend. Problem came after some time when the fertility started to stagnate and the first numerous age cohorts started to approach pension age.

Pension systems, that were adapted to growing population, are not prepared for such change. The main emphasis of these pension systems was placed on first pillar which in combination with low dependency ratio enabled smaller contribution by employees and at the same time bigger old-age pensions for elderly people. When dependency ratio started to grow, first pillar started to create large deficits, moreover without any outlook to improvement. These deficits cause worries to fiscal policies of individual countries. As a result, reforms to pensions systems have been either already implemented (or are to come) to improve the this state.

Sustainability of pension systems is object of interest to many organizations. The EU issues regularly publication called Ageing report (e.g. European Commission (2009), European Commission (2012a)), where it captures what has been done in individual countries in last years in field of social insurance policies, especially in health care, education, and old-age pension systems, and what should be done further to not endanger EU stability with growing debts of individual countries. It also launches directions and debates on this topic in White and Green papers on pensions (e.g. European Commission (2010), European Commission (2012b)). Similar activity is performed by OECD that publishes reports about pension systems in OECD countries called OECD Pension outlook (e.g. OECD (2012)) and OECD Pensions at

Glance (e.g. OECD (2013)). These reports examine changing pension landscape in Europe and focuses on automatic adjustment mechanisms and coverage. They also map evolution of private pension systems. OECD plans to publish these reports in two years interval which underlines the importance of this topic. From time to time, also other organizations publish reports concerning pension system, e.g. World Bank (e.g. Musalem & Pasquini (2012)) or IMF (e.g. Clements *et al.* (2013)), but these reports are not published regularly.

Motivation of this study is to find out what is the result of previous efforts to make pension systems in the EU sustainable. To investigate sustainability, we use methodology on calculation of Implicit pension debt (IPD) introduced by Holzmann *et al.* (2004). IPD is type of intergenerational accounting which captures present value of sums of differences of pension system incomes and expenditures over the time. In contrast to other available fiscal policy measures, IPD enables us to capture future impact of introduced pension reforms. This feature makes it the ideal scale for our analysis. Further, using IPD estimates we will be able to analyze typical components of pension reforms and its potential impact on IPD. As a counter-measure of IPD, we will also outline changes in intergenerational redistribution of money in pension systems as a measure of adequacy to show righteousness of pension systems, since it is one of the most perceived fact by society.

For governments, it is difficult to design a pension reform, as they have to find a delicate balance between pension system sustainability and adequacy, and also should respect fairness of intergenerational redistribution of funds. Results of our analysis will help to better estimate impacts of proposed changes to pension system in various aspects of social welfare.

Study most similar to this one, i.e. Soto *et al.* (2011), investigated impact of pension reforms to IPD in eight European countries. As opposed to our study, it did not investigate impact of individual reform components on the IPD. Further, there were many papers examining IPD of individual countries or group of countries (e.g. Kaier & Müller (2013), Schneider (2011), Bank for international settlements (2008)), but these studies do not investigate how IPD evolved in the past.

Our paper will have the following structure. In chapter 2 we will briefly describe old-age pension systems in the EU. Starting with short introduction of functions of pension systems, we will then approach to description of common structure of pension systems which usually consists of a combination of three main pillars. With their description we will proceed to indicate main challenges that pension systems are facing now. We will further move to description of pension reforms which took place in the EU27 in the time period 1993 - 2013. We will depict the facts why the reforms were introduced and how they should help. Also, we analyze individual components of the reforms to better understand results of later analyses. In chapter 3 we will

lay foundations of IPD model. We will start with introduction of its basics and proceed to explanation what does the IPD tell us and what does it cover. Further, we will delineate methodology on how we will analyze the impact to IPD of both pension reforms and its components. Data needed for estimation of IPD will be introduced in section 4. First, we will introduce sources of the data, then we will describe methodology used to calculate it. Also, macroeconomic assumptions used in this paper, especially regarding inflation, discount factor and wage growth, will be specified. Results of the model will be presented in section 5. We will start with analyzing IPD estimates in individual countries. Proceeding to the main part, we will compare IPD before pension reforms and after pension reforms and analyze these changes. Further, we will investigate impacts of individual components of pension reforms. In the end, we will test sensitivity of the results on applied assumptions and input data and compare our findings to similar studies that provided this research previously. Last, but not least, we will investigate changes in redistribution of funds among generations to outline impact on welfare of society. In section 6 we will revise the most important findings of our paper and make conclusion.

Chapter 2

Pension systems and their reforms

In the world, Europe is the most social region. Money acquired from high taxes is redistributed to people who are at risk of poverty. Europe spends every year a big part of its GDP on social assistance programs, protecting people from poverty. Besides social assistances, education, health care etc., people get used to fact that governments will also support them in retirement. This fact currently concerns governments of countries in the EU, because the pension expenditures are steeply growing and it is harder and harder to keep them at reasonable level.

To understand better why the expenditures are growing, what are the determinants of this growth, why it is hard or almost impossible to avoid it, we will look closer at pension systems. We will start with basics of the pension system, depicting main features, usual typology, and functions of its pillars. Then we will look specifically at pension systems in the EU. In next section we will take a look at factors influencing pension expenditures and in the last section we will look closer on reactions of pension funds to these changes.

2.1 Pension systems

In the most traditional societies there was no need of pension systems. Strong relationships in communities were reflected in intragenerational as well as intergenerational solidarity and as a result of this fact, working people inside these communities cared for elder people unable to work. In present days, people are very often forced to leave these "communities" because of work etc. These people do not supply their communities anymore and are losing its right for care in advanced age.

Country governments took initiative to solve this issue. They started to organize compulsory pension system that cares for people in advanced age. According to Schwarz (2006) there are two main reasons why the governments should participate

in pension systems. Firstly, workers may suffer from "myopia"[1] - they do not think about old age when they are young and when they realize that they have to save money, it is usually to late to save sufficient amount of money to secure their life in pension. Second reason is moral hazard of workers. In particular, workers may consume as much as they can when they are young in expectation that country will take care of them when they are old[2].

Early simple pension systems evolved in modern pension systems that usually consist of three main pillars proposed first by Pordes (1994) in a World Bank study[3]. This paper emphasizes the importance of having diversified pension system containing three pillars[4], see figure 2.1. First, every country should have mandatory public-managed pillar that ensures redistributive function of pension savings and through this eradicate poverty of pensioners[5]. This pillar should be according to this paper supported by funded privately managed second pillar which should ensure additional savings in form of earnings-related pension. Last but not least, there should be a voluntary pillar where people can save additional money for pension age. Because of importance of these pillars, we will describe them thoroughly in following subsections.

2.1.1 General structure and functions of pension systems

First pension pillar

First pension pillar builds a backbone of a pension system. It is the main safety net that protects old-age pensioners from poverty connected with inability to work[6](OECD (2006)). First pension pillar is characterized by payments from employed population to old-age pensioners managed by countries' governments. These payments are generally collected in form of taxes from wages on Pay-As-You-Go (PAYG) basis.

There are three schemes that determines contributions and pension benefits in the system: Defined benefit (DB), Defined contribution (DC) and Notional defined contribution (NDC)(OECD (2006)). In DB schemes, amount received in retirement depends on a formula specified by government. Variables in this formula determin-

[1]Word Myopia in this context was used Willmore (2000)

[2]This risk also described by Orszag & Stiglitz (1999) and Willmore (1999)

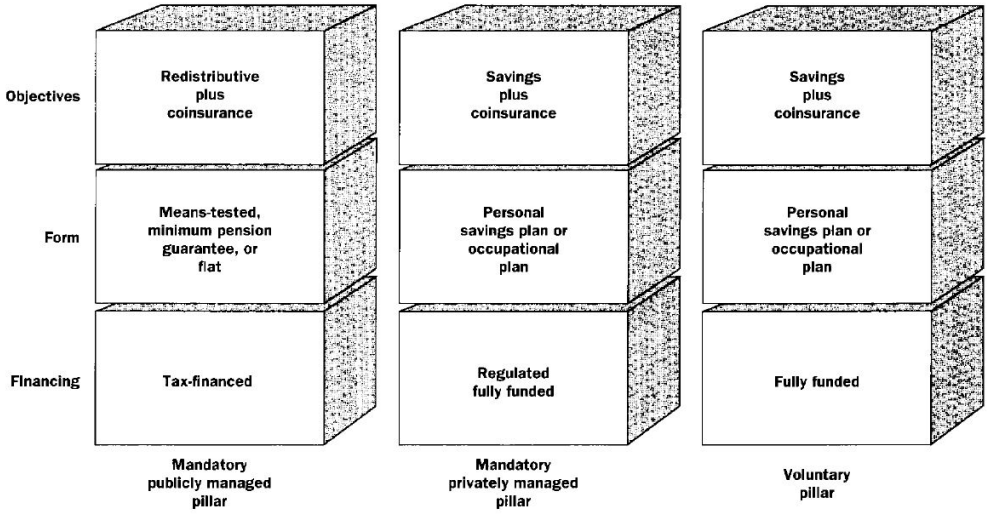
[3]Few countries in the EU (e.g. Cyprus, Denmark, France, UK, Germany) have also implemented so called fourth pillar. This pillar is not formally defined. Generally, it can be any provision helping pensioners to stay longer in work (Reday-Mulvey (1993)) or one of various forms of family support and other social programs (Doležal (2012)). As this pillar has only small impact on our analysis, we will not mention in further.

[4]Implementation of three pillars in pension system is also recommended by Wagner (2005).

[5]According to Zaidi (2010) 19% of pesnioners in the EU were at risk of being poor in 2008.

[6]According to Zaidi (2010) 19% of pesnioners in the EU were at risk of being poor in 2008.

Figure 2.1: Structure of three-pillar pension system



Source: Pordes (1994)

ing pension benefits are generally number of contribution years and a measure of wage[7](OECD (2006)). In the DB scheme pensions can be paid out in various forms (Pordes (1994)). These forms determine how redistributive the pension system will be. The most common form is earnings-related pension benefit. In this form, pension benefit depends on earnings in working life. In other words, the more the person earned, the higher his pension benefit will be. Earnings-related pensions are often backed by means-tested pensions or minimum pensions. Means-tested pensions redistribute money to pensioners who do not fulfill conditions for earnings-related pension or have accrued to small earnings-related pension. Minimum pension is given to everyone whose earnings-related pension is under specified level. As a result means-tested and minimum pensions fight poverty[8]. Flat pensions can be also used to limit poverty among pensioners. This pension is created by given amount of money and is distributed to all pensioners living in given country regardless any other fact (European Commission (2012a)).

In DC scheme, pension benefit is not defined and it depends solely on workers' contributions. In this system, every worker has its own account where his contributions are saved, and the total savings are converted into the pension-income stream at the end of working life. As a result, there is no possibility to redistribute money.

[7]This can be either the highest reached wage in working life, wage when reaching retirement, total wage earned in working life or average wage in given number of years in life(OECD (2006))

[8]There's a lot of literature investigating number of pensioners at risk of poverty. E.g. Zaidi (2010) says that in the EU there are 19% of pesnioners at risk of being poor in 2008.

NDC scheme contains features of both DB and DC schemes. As in DC scheme, earnings of participants are recorded on individual accounts managed by government with a predetermined interest rate. When reaching the retirement age, the amount is converted to annuity based on current life expectancy. The main difference from classical DC is that the amounts and interests are only notional - it means that the contributions are not physically credited to individual accounts, but are used to pay current pension expenditures which is commonality with DB scheme. This scheme is popular [9] and countries replace their old pension systems with NDC[10]. Usually, only DB and NDC schemes are used in first pillar[11].

First pillar serves as protection from several risks. First, it reduces risk of poverty, as government redistributes the money to poorer pensioners[12]. Second, it protects from moral hazard as contributions to pension system are mandatory[13](Schwarz (2006)). Third, it protects pensioners from inflation, private market failures, recessions and low return from investment using its unique feature that government immediately redistributes contributions to current pensioners (Pordes (1994)). Fourth, the government power of taxation ensures that the pensions will be paid.

According to Pordes (1994), first pillar should contain only flat rate basic pension to protect pensioners from poverty and the earnings-related pensions should be moved to second pillar. Reason is that government can easily predict future expenditures which will be more stable. He also mentions that first pillar should cover all population including the low-income part, e.g. agriculture workers, domestic servants, caregivers, etc.

Second pension pillar

Second pension pillar introduces private mandatory savings. It is a funded system which recipients and government pay into. It is usually a DC scheme, i.e. each worker has its own account in which contributions are saved and the accumulated capital is then paid out as pension income (OECD (2006)). Second pillar is organized by governments, but managed by chosen private companies which collect all funds. In comparison to first pension pillar, second pillar is missing redistribution of money to

[9]For example, Vostatek (2012) recommends usage of NDC in combination with solidarity fund and complementary savings

[10]For example, Sweden switched from DB to NDC in 1997 (ISSA)

[11]In the EU, only DB and NDC schemes are used in first pillar (ISSA), therefore we will further focus on these two schemes.

[12]Among others, poverty fighting is regularly reported e.g by ASISP Annual national reports(e.g. Jankauskiene & Medaiskis (2011))

[13]This was already mentioned in the beginning of chapter 2

poorer pensioners. It is mainly aimed at increasing the replacement rate[14] and not fighting poverty (OECD (2006)).

This pillar has form of personal savings accounts or occupational plans (Pordes (1994)). Personal savings accounts are organized by governments, but are managed privately (Pordes (1994)). Occupational schemes are schemes provided by employers. Employees are members after being employed (European Commission (2012a)).

Second pension pillar has ability to protect workers from political and economic risks that first pillar is prone to[15] (Pordes (1994)). Further, second pension pillar increases capital accumulation; money saved in second pillar are invested in financial markets and through this it boosts financial market development (Pordes (1994)). This is confirmed by Sinn (2000) who says that transition to partially funded system may be a way to overcome the current demographic crisis because it replaces missing human capital with real capital. Moreover, it helps to smooth tax and child rearing costs across the generations.

Third pension pillar

Third pension pillar enables people to voluntary save for retirement. It is designed for people who want to increase their replacement rate through optional savings. This pillar finishes protection of pension income, because diversification is the best protection in uncertain world (Pordes (1994)).

2.1.2 Pension systems in the EU

There is a big diversity among pension systems in the EU. Different traditions on how to provide old-age pension arrangements in these countries evolved in variance of pension system approaches. In particular, countries in Western Europe (Denmark, Ireland, Spain, Netherlands, Portugal, Sweden, UK) get used to occupational pension plans and private savings, while countries from Eastern Europe rely on government. Some influence to pension system diversity can be attributed to different phases of processes of pension reforms[16] (European Commission (2012a)).

In the EU, all 27 countries have already implemented the pillar structure described in section 2.1.1. Although not all pillars exist in all EU27 countries, functions of pension system (redistribution to fight poverty, earnings-related savings, voluntary

[14]Definition varies in literature. In this paper we will define it as first pension income relative to earnings before retirement

[15]However, also second pillar faces political threats. An example of such risk is nationalization of second pension pillar in Hungary in 2011 (ISSA).

[16]Especially differences in pension age which is raised dramatically in last years. See section 2.3.1 for more details.

savings) are in almost all cases fulfilled. In table 2.1 we can see the combinations of pillars implemented in every country.

First pillar is implemented in every country in EU27. Looking deeper on the structure, 24 of these countries provides pensions as solely earnings-related pensions[17] or as earnings-related pensions in combination with flat rate[18]. These pension are backed by flat rate pensions in 4 cases, by means-tested pensions in 6 cases and by social allowance in 16 cases (for list of countries see table 2.1). The remaining 3 countries (Denmark, Ireland, Netherlands) do provide flat rate pensions supplemented by means-tested pensions or social allowance.

There are also differences in schemes applied in first pillar. In table 2.2 we can see that countries prefer different types of main schemes. DB scheme is preferred in majority, i.e. 23 countries. In 3 countries from that (Ireland, Greece, Malta) the DB scheme is supplemented by flat rate. Points system which are modified DB schemes, are used in Germany, Romania and Slovakia. In the rest of countries (Italy, Latvia, Poland, Sweden) NDC scheme is applied.

Financing of first pension pillar also differs among countries. First pillar is generally financed by contributions on PAYG basis. Contribution rates vary among countries, see table 2.3. Starting on 1% in Denmark the spectrum is filled up to 33% in Italy (ISSA). In addition to that few countries (Denmark, France, Portugal) introduced taxes to finance their pension systems[19]. Incomes of pension systems are usually immediately used for pension expenditures, so there are no free money left. Moreover, governments usually have to subsidize its system from country budgets[20]. Nevertheless, there are countries that were able to create reserves over past years. The range of reserves starts in Poland (0.8% of its GDP), continues over Belgium, France, Ireland, Cyprus, Luxembourg, and Finland and ends in Sweden (25% of its GDP) (European Commission (2012a), OECD (2013)).

In last years some countries (Italy, Finland, Portugal, Sweden, Germany) have implemented "sustainability factor" or other "reduction coefficients" that reduce future pension expenditures depending on e.g. future demographic changes (European Commission (2012a)).

One of key parameters of pension systems is pension age. As we can see in table 2.3, pension age often differs for males and females. For males, pension age in 2013 varies in range from 62 in Malta, Latvia and Slovakia till 66 years in France and

[17] In the UK, only flat rate pension called State first pension is mandatory, earnings-related pension called State second pension is provided on voluntary basis (European Commission (2012a))

[18] Hybrid system in Spain provides earnings-related pension for private pensioners and flat rate pensions for public employees (European Commission (2012a)).

[19] All 3 countries specified part of VAT tax that is send to pension system (ISSA)

[20] In addition to that governments usually pay expenditures on means-tested and minimum pensions only from taxes (European Commission (2012a)).

Table 2.1: Pension system pillars in EU27

Country	Minimum pension /Social Allowance	First pillar	Second pillar	Third pillar
BE	MT - SA	ER	X	V
BG	MT - SA	ER	M young (1960); M prof	V
CZ	FR	ER	X	V
DK	FR + MT suppl	FR + MT suppl	X	V
DE	MT - SA	ER	X	V
EE	FR	ER	M - young (1983)	V-old
IE	MT - FR + SA	FR	X	V
EL	MT - FR	ER	X	V
ES	MT	ER - priv; FRw - pub	X	V
FR	ER/MT - SA	ER	X	V
IT	MT + SA	ER	X	V
CY	MT	ER	X	X
LV	MT - SA	ER	M - young (1971); V - old	V
LT	SA	ER	V	V
LU	MT - SA	ER	X	V
HU	MT - SA	ER	V	V
MT	MT - SA	FR + ER	X	V
NL	SA	FR	X	V
AT	MT - SA	ER	X	V
PL	MT	ER	X*	V
PT	MT - SA	ER	X	V
RO	SA	ER	M	V
SI	MT - SA	ER	X	V
SK	MT - SA	ER	M/V new	V
FI	MT	ER	X	V
SE	MT	ER	M	V
UK	FR + MT - SA	ER - V	X	V

*Note: Poland canceled second pillar in 2013

Key:

MT	Means tested
FR	Flat rate
FRw	Flat rate by wage categories
ER	Earnings related
SA	Social allowance/assistance
X	Does not exist
V	Voluntary participation in the scheme
M	Mandatory participation in the scheme
public	Public sector employees
private	Private sector employees
new	New labour market entrants
prof	Only for selected professions
young(X)	Only for people born in year X and after
old	Only for people other than young

Source: European Commission (2012a), updated to 2014

Ireland. In 17 countries pension age for females is equivalent to males pension age. Partly this is result of governments willing to increase participation rate of females and partly it is caused by EU directive 79/7/EEC equalizing males and females treatment in social security (Renga *et al.* (2010)). Female pension age starts on 60 years in Austria, Bulgaria, Czech Republic, Poland, and Romania and ends on 66 years in France and Ireland. Majority of countries in the EU have legislated a specific pension age. Some countries (Cyprus, Denmark, Greece, Spain, Italy, Netherlands, Slovakia) have already adapted to the trend of population aging and linked the pension age to life expectancy of population. This measure will automatically adapt the pension expenditures[21]. In Czech Republic pension age increases every year and in Sweden the age was not set at all and there was only recommended pension age set and every inhabitant can choose when to retire[22](Social Protection Committee (2013)).

Table 2.2: Main pension schemes in EU27

Country	Type
BE	Defined benefit system
BG	Defined benefit system
CZ	Defined benefit system
DK	Defined benefit system
DE	Point system
EE	Defined benefit system
IE	Flat rate + Defined benefit system
EL	Flat rate + Defined benefit system
ES	Defined benefit system
FR	Defined benefit system
IT	Notional defined contribution system
CY	Defined benefit system
LV	Notional defined contribution system
LT	Defined benefit system
LU	Defined benefit system
HU	Defined benefit system
MT	Flat rate + Defined benefit system
NL	Defined benefit system
AT	Defined benefit system
PL	Notional defined contribution system
PT	Defined benefit system
RO	Point system
SI	Defined benefit system
SK	Point system
FI	Defined benefit system
SE	Notional defined contribution system
UK	Defined benefit system

Source: European Commission (2012a)

Twenty countries also enable its inhabitants to enter early retirement. It is possible to enter early retirement up to 10 years prior to regular pension age[23], however there is reduction of old-age pension benefit for every exploited year of early retirement to demotivate people from exploiting it.

Every pension system is also targeting chosen replacement rate. These rates differ based on income during life and pensions included in calculation. In table 2.3 we can

[21]See European Commission (2012a) for more information about this topic
[22]However, people in average choose to retire in the recommended retirement age
[23]case of Portugal(ISSA)

find rates for average wage and only public old-age pensions. As we can see lowest replacement 35.7% can be found in Malta, while highest rate 54.7% is in Portugal. Pensions are often taxed in EU27 countries. Pension income taxation can be found in 23 countries, see table 2.3 for details. In 14 countries pensions are taxed but there are tax exemptions (e.g. Finland, Slovenia, Czech Republic) which make low and average pension nontaxable and only high pensions are taxed. Four countries do not tax pensions at all.

Table 2.3: Key parameters of first pillars in EU27

Country	Contribution rate	Pension age M	Pension age F	Early retirement age M	Early retirement age F	Average replacement rate	Average net pension	Taxes or social contribution	Allowance
AT	22,8	65	60	60	57	49,5	19 019,5	Yes	No
BE	16,9	65	65	60	60	39,6	13 445,8	Yes	No
BG	16,0	63	60	63	60	42,0	1 669,7	No	No
CY	10,2	65	65	63	63	49,0	11 485,6	Yes	Yes
CZ	26,0	63	60	60	57	43,5	4 916,4	Yes	Yes
DK	1,0	65	65	65	65	46,1	24 182,3	Yes	No
EE	20,0	63	62	60	59	39,8	3 780,0	Yes	Yes
FI	23,3	65	65	62	62	48,1	17 569,9	Yes	No
FR	15,2	66	66	61	61	51,7	15 887,6	Yes	No
DE	19,5	65	65	63	63	42,0	11 924,0	Yes	Yes
EL	20,0	65	65	58	58	44,6	12 280,0	Yes	Yes
HU	31,0	63	63	63	63	44,4	3 919,2	No	No
IE	10,0	66	66	66	66	49,3	17 798,0	Yes	No
IT	33,0	65	61	61	61	52,0	13 349,5	Yes	No
LV	25,3	62	62	60	60	48,2	3 632,3	Yes	Yes
LT	26,3	63	61	58	56	42,7	2 946,7	No	No
LU	16,0	65	65	60	60	54,0	26 646,5	Yes	Yes
MT	15,0	62	62	59	59	35,7	5 162,2	Yes	No
NL	17,9	65	65	65	65	46,3	12 474,0	Yes	Yes
PL	19,5	65	60	65	60	41,4	4 007,2	Yes	Yes
PT	21,0	65	65	55	55	54,7	6 789,1	Yes	Yes
RO	18,0	65	60	60	55	39,3	2 128,5	Yes	Yes
SK	18,0	62	62	60	60	40,5	3 737,3	No	No
SI	24,4	64	61	59	59	39,2	7 036,3	Yes	Yes
ES	21,2	65	65	61	61	45,4	10 226,2	Yes	No
SE	17,2	65	65	61	61	40,2	14 346,1	Yes	Yes
UK	19,4	65	62	65	62	48,0	14 157,5	Yes	Yes

Source: ILO, OECD, EU, ISSA, Author's computation

To secure purchasing power of pensions, pensions are indexed and valorized[24]. Current rules can be found in table 2.4.

The most common type of indexation used in 13 countries is indexation to change of prices or equivalent measures[25]. Other possibility is the indexation to wage growth or equivalent measures[26] or combination of these variables. In Ireland and Lithuania

[24]Valorization rules are applied on reference earnings before retirement when calculating pension benefits. Indexation is applied for yearly growth of pension benefits.

[25]E.g. indexation by expected inflation in Italy

[26]E.g. growth of social contributions

Table 2.4: Indexation and valorisation rules in 2012 in EU27

Country	Valorisation variable(s)	Indexation variable(s)	Bindness by law
AT	Wages	Prices	Yes
BE	Prices	Prices and living standard	Yes
BG	Wages	Prices and wages	Yes
CY	Wages	Wages and Prices	Yes
CZ	Wages	Prices and wages	Yes
DK	Not applicable	Wages	Yes
EE	Social taxes	Prices and social taxes	Yes
FI	Prices and wages	Prices and wages	Yes
FR	Prices	Prices	Yes
DE	Wages	Wages	Yes
EL	Yearly decree	Prices and GDP	Yes
HU	Wages	Prices and wages	Yes
IE	Not applicable	No rule	No
IT	GDP	Prices	Yes
LV	Contribution wage sum index	Prices (as of 2014)	Yes
LT	Yearly discretionary decision	Yearly discretionary decision	No
LU	Prices and wages	Prices and wages	Yes
MT	Cost of living	Prices and wages	Yes
NL	Not applicable	Wages	Yes
PL	NDC 1st: Wages, NDC 2nd: GDP	Prices and wages	Yes
PT	Prices	Prices and GDP	Yes
RO	Prices and wages	Prices and wages	Yes
SK	Wages	Prices and wages	Yes
SI	Wages	Wages	Yes
ES	Wages	Prices	Yes
SE	Wages	Wages	Yes
UK	Prices, wages and GDP	Prices, wages and GDP	Yes

Source: DICE Database (2014)

governments decide on pension growth every year [27]. In few countries (e.g. Greece, Czech Republic) governments decide on pension growth as well, but are bound by minimum growth defined by law. Valorization rules are slightly more generous then indexation rules as it is more linked to wages growth however for many countries the rules are comparable.

Usually, first pillar contains more types of pension benefits (see table 2.5). Largest part, approximately 80% of pension expenditures, is created by old-age pensions including early retirement pensions. These pensions are supplemented with survivor and disability pension that together creates approximately 20% of total expenditures on public pensions. In 7 countries there are also minor expenditures on occupational pensions and in 9 countries on expenditures connected with private pensions.

[27]However, in Lithuania the indexation was not performed for many years(Jankauskiene & Medaiskis (2011), OECD (2014)) and therefore Lithuania is pushed by EU to introduce clear rules of indexation independent on political decisions(Jankauskiene & Medaiskis (2011))

Table 2.5: Expenditures on pensions in EU27 by type of pension(% of GDP)

Country	Public pensions	Old-age and early pensions	Of which: Earnings-related pensions	Disability pensions	Survivors pensions	Occupational pensions	Private pensions
BE	11,9	9,9	9,8	1,0	1,1	-	-
BG	8,7	7,1	6,7	1,2	0,4	-	-
CZ	8,6	6,8	6,8	1,1	0,7	-	-
DK	10,4	8,2	1,3	2,2	-	5,0	-
DE	10,5	8,8	8,8	-	1,6	-	-
EE	7,8	6,6	-	1,1	0,1	-	0,1
IE	8,3	6,4	-	1,4	0,5	2,3	-
EL	14,1	10,1	8,8	1,2	1,6	-	-
ES	10,4	7,3	7,2	1,1	2,0	0,4	0,3
FR	14,4	11,6	11,5	0,9	1,9	-	-
IT	14,9	12,1	11,9	0,3	2,4	-	-
CY	8,7	6,9	6,5	0,4	1,5	-	-
LV	7,6	6,8	6,8	0,6	0,1	-	0,0
LT	7,4	5,3	5,2	1,7	0,4	-	0,0
LU	9,9	7,1	7,1	0,9	1,9	-	-
HU	11,9	10,3	10,1	1,0	0,5	-	0,0
MT	10,5	6,3	5,9	0,5	3,8	-	-
NL	6,8	5,2	5,2	1,5	0,1	5,1	-
AT	14,4	10,1	9,8	2,3	2,0	-	-
PL	10,7	9,4	-	0,9	0,5	-	0,0
PT	13,3	10,9	9,5	0,8	1,7	0,6	-
RO	9,3	7,8	7,8	0,9	0,5	-	0,0
SI	11,8	8,7	8,7	1,4	1,7	-	0,0
SK	8,1	6,1	6,1	1,1	0,9	-	-
FI	12,8	10,5	9,8	1,4	0,8	-	-
SE	9,7	8,1	7,2	1,1	0,4	1,8	0,2
UK	7,4	7,4	1,0	-	-	2,0	-
EU27	11,2	9,2	7,7	1,0	1,5	2,0	0,2

Source: European Commission (2012a)

Some member states have also boosted pension savings by second pension pillar. There are different traditions among EU27 countries on how to provide second pillar. Western-European countries mostly continue in tradition of occupational pension funds, while Eastern-European countries tend to state-organized second pillar savings.

Eight member states (e.g. Bulgaria, Latvia, Lithuania, see table 2.1 for complete list) provide personal savings accounts to its inhabitants. Participation in second pillar is often mandatory for people beneath some age and voluntary for the rest (Bulgaria, Estonia, Latvia), or for some professions (Bulgaria). In Sweden and Romania participation is mandatory for everybody which is in contrast to Lithuania and Hungary where it is voluntary for everybody (European Commission (2012a)). In Slovakia people can choose to participate but after entering second pillar the participation is mandatory. Funding of second pillar is hybrid in all countries: Funds

redirected from first pension pillar[28] create one part of contributions and the other part are private contributions paid by participants. Contributions paid by participants are set as percentage of their gross wage(European Commission (2012a)). Lowest contribution rate of 2.5% is set in Sweden while the highest contribution rate of 8% is paid in Hungary[29].

Occupational pension schemes are popular in Western Europe, especially in UK and the Netherlands where is allocated about 80% of EU occupational funds' total assets(EIOPA (2013)). Number of these funds is slightly decreasing in time because of many mergers, but the number of participants is increasing every year ((EIOPA (2013))).

Pensions from second pillar are often taxed as personal income. There are two options how to tax pensions - either the contributions or the final pensions can be taxed. Nevertheless, governments usually tend to tax only once[30].

Except Cyprus, all EU27 countries provide also private voluntary pension savings using third pillar. To motivate people, governments have introduced incentives to private voluntary savings. These incentives are either tax deductions[31] (e.g. Netherlands, Estonia) or it is combination of tax incentive and state contribution (e.g. Czech Republic).

Table 2.6: Contribution rate to second pillar in EU27

Country	Participation	Contribution rate
BG	Mandatory	7%
EE	Mandatory	6%
LV	Mandatory/Voluntary	6%
LT	Optional	6%
HU	Optional	8%
RO	Mandatory	4.5%
SK	Mandatory/Voluntary	4%
SE	Mandatory	2.5%

Source: ISSA

Despite World Bank (Pordes (1994)) suggestions of first pillar providing flat rate pension, second pillar providing earnings-related pension and third pillar enabling voluntary savings, earnings-related pensions are often provided by first pension pillar and second pillar is not implemented. Therefore, first pillar faces more significant growth of pension expenditures in case that population gets old to fast in comparison to World Bank suggestions. As a

[28]The only exception is Estonia which did not transferred part of funds from first pillar, but rather added new contribution to fund second pillar (ISSA)

[29]In Hungary, funds accumulated in second pillar were nationalized. Second pillar participants are allowed to participate further but at disadvantageous conditions, therefore majority of participants transferred their funds to first pillar (ISSA).

[30]More information about taxation of second and third pillar can be found in Whitehouse (1999) and CEA Insurance of Europe (2011)

[31]The tax deduction is either on contributions, annuity or both (CEA Insurance of Europe (2011))

consequence, pension system as a whole is more sensitive to population aging which causes excessive growth of pension expenditures that will have to be covered by government.

2.2 Demographic and other trends changing the patterns

"Aging seems to be the only available way to live a long life."
Kitty O'Neill Collins, American stuntwoman and racer (*1952)[32]

Pension system income and expenditures must be in balance so that it is sustainable in long run to enable continuous payments of pensions. In case that pension system collapses pensions will be not paid out which will lead to untrustworthiness of system and government. From this reason, it is very important to carefully set all parameters of this system. It is not an easy task, since the circumstances which are determining parameters of pension systems is changing all the time.

Following Marcinkiewicz & Chybalski (2014), pension expenditures over GDP can be rewritten to five main determinants that need to be taken into account when setting the parameters of pension system expenditures, see equation 2.1[33].

$$\frac{Pension\ expenditure}{GDP} = \frac{Number\ of\ pensioners \times Average\ pension}{GDP} = \\ = \underbrace{\frac{Population\ 65+}{Population\ 20-64}}_{Dependency\ ratio} \times \underbrace{\frac{Number\ of\ pensioners}{Population\ 65+}}_{Coverage\ ratio} \times \underbrace{\frac{Population\ 20-64}{Working\ people\ 20-64}}_{1/Employment\ rate} \times \\ \times \underbrace{\frac{Average\ pension}{GDP/Hours\ worked\ 20-74}}_{Benefit\ ratio} \times \underbrace{\frac{Working\ people\ 20-64}{Hours\ worked\ 20-64}}_{1/Labor\ intensity} \times \underbrace{\frac{Hours\ worked\ 20-64}{Hours\ worked\ 20-74}}_{Residual} \tag{2.1}$$

Impact of these parameters can be seen in table 2.7. Determinant, that increases pension expenditures most, is dependency ratio, followed by coverage ratio, employment rate, benefit ratio and labor intensity. Bellow we will depict main changes that are happening to every parameter.

[32] Available at http://izquotes.com/quote/40416

[33] Original number of determinants was four. We expanded this formula by one more determinant based on European Commission (2012a).

Table 2.7: Decomposition of gross public pension expenditure change over 2010-2060 (in p.p. of GDP)

	2010 level	Dependency ratio contribution	Coverage ratio contribution	Employment effect contribution	Benefit ratio contribution	Labor intensity contribution	Residual	2060 level
BE	11,0	7,6	-0,9	-0,3	-0,6	0,0	-0,2	16,6
BG	9,9	8,8	-3,9	-0,8	-2,1	0,0	-0,8	11,1
CZ	9,1	9,3	-4,6	-0,6	-0,2	0,0	-1,1	11,8
DK	10,1	5,9	-4,2	-0,4	-1,2	0,0	-0,6	9,5
DE	10,8	7,9	-1,8	-0,5	-2,2	0,0	-0,9	13,4
EE	8,9	6,7	-2,7	-1,1	-3,3	0,0	-0,6	7,7
IE	7,5	5,3	-2,0	-0,4	0,1	0,0	1,2	11,7
EL	13,6	10,4	-3,4	-1,9	-3,6	0,1	-0,6	14,6
ES	10,1	9,7	-0,8	-2,2	-2,3	0,1	-0,9	13,7
FR	14,6	9,1	-3,5	-1,2	-3,1	0,0	-0,8	15,1
IT	15,3	9,5	-5,5	-1,3	-2,9	0,0	-0,8	14,4
CY	7,6	10,6	2,8	-0,6	-3,4	0,0	-0,6	16,4
LV	9,7	7,0	-1,9	-1,2	-6,8	0,0	-0,9	5,9
LT	8,6	8,2	-2,9	-1,1	-0,2	0,0	-0,5	12,1
LU	9,2	11,2	0,3	0,1	-2,1	0,1	-0,1	18,6
HU	11,9	11,1	-4,3	-1,3	-1,8	0,0	-0,9	14,7
MT	10,4	11,3	-2,6	-1,5	-1,0	0,1	-0,8	15,9
NL	6,8	6,0	-1,0	-0,2	-0,8	0,0	-0,4	10,4
AT	14,1	11,0	-2,9	-0,6	-4,5	0,1	-1,1	16,1
PL	11,8	14,0	-5,0	-0,4	-8,7	0,0	-2,0	9,6
PT	12,5	10,4	-2,5	-1,0	-5,5	0,0	-1,1	12,7
RO	9,8	12,9	-4,7	0,4	-3,7	0,0	-1,2	13,5
SI	11,2	12,8	-3,1	-1,0	-0,9	0,0	-0,8	18,3
SK	8,0	13,5	-3,9	-0,5	-2,8	0,0	-1,0	13,2
FI	12,0	8,6	-3,2	-0,5	-0,9	0,0	-0,7	15,2
SE	9,6	5,0	-0,8	-0,5	-2,7	0,0	-0,4	10,2
UK	7,7	3,1	-1,4	-0,2	0,8	0,0	-0,8	9,2
EU27	11,3	8,5	-2,9	-0,8	-2,7	0,1	-0,6	12,9

Source: European Commission (2012a)

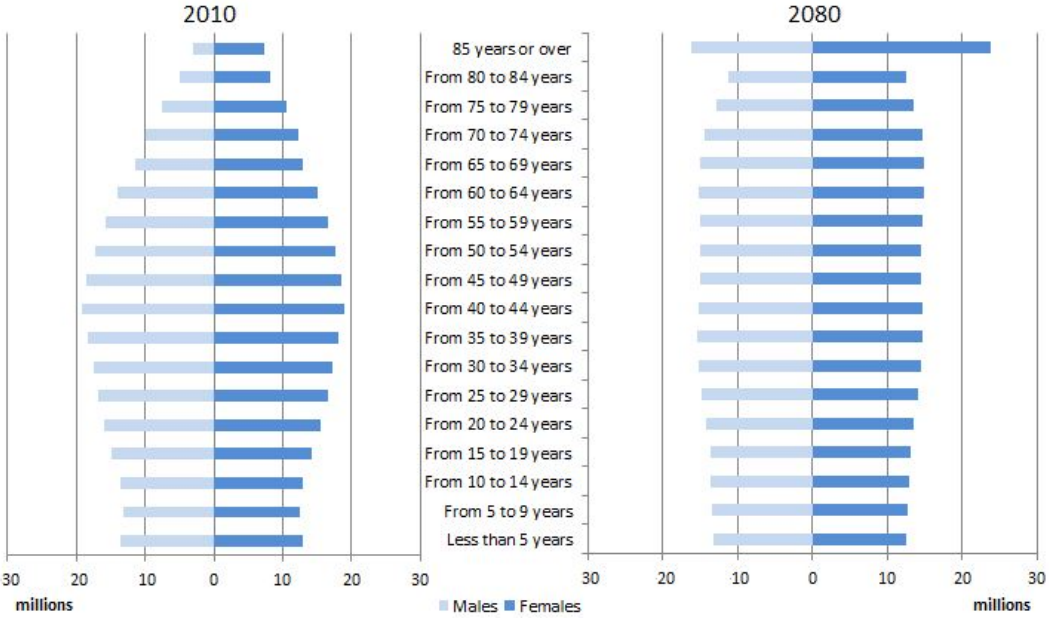
Dependency ratio

Population is a flow variable. Fertility rate, mortality rate, and life expectancy determine size and growth of population. Shocks to these variables can consequently cause fast changes to population. Since start of 20th century, there have been numerous shocks to these variables - e.g. World War the first, boom between wars, World War the second, political changes after the wars. As a result, these variables were not stable and created big differences among cohort sizes of population in all countries of the EU. In combination with growing life expectancy in current days the population pyramid has changed dramatically. Figure 2.2 shows this transformation of population pyramid as predicted by EUROPOP 2013.

Speaking about 2010 population pyramid, 66% of population was in productive age, while only 34% was in non-productive age. This fact is reflected in dependency ratio[34] of 0.5 in 2010(EUROPOP 2013, Author's computation). In 2080, the most numerous age cohorts that were in productive age in 2010 will be already in post-

[34]Dependency ratio is defined as ratio of people in non-productive age and people in

Figure 2.2: Population pyramid of the EU27 countries in 2010 and 2080



Source: EUROPOP 2013, Author's computation

productive age. Further, because of low fertility, the cohorts in productive age will be less numerous in comparison to 2010. As a result, only 57% of population will be in productive age and the rest will be in non-productive age. Figure 2.3 shows changes among cohorts sizes between 2010 and 2080.

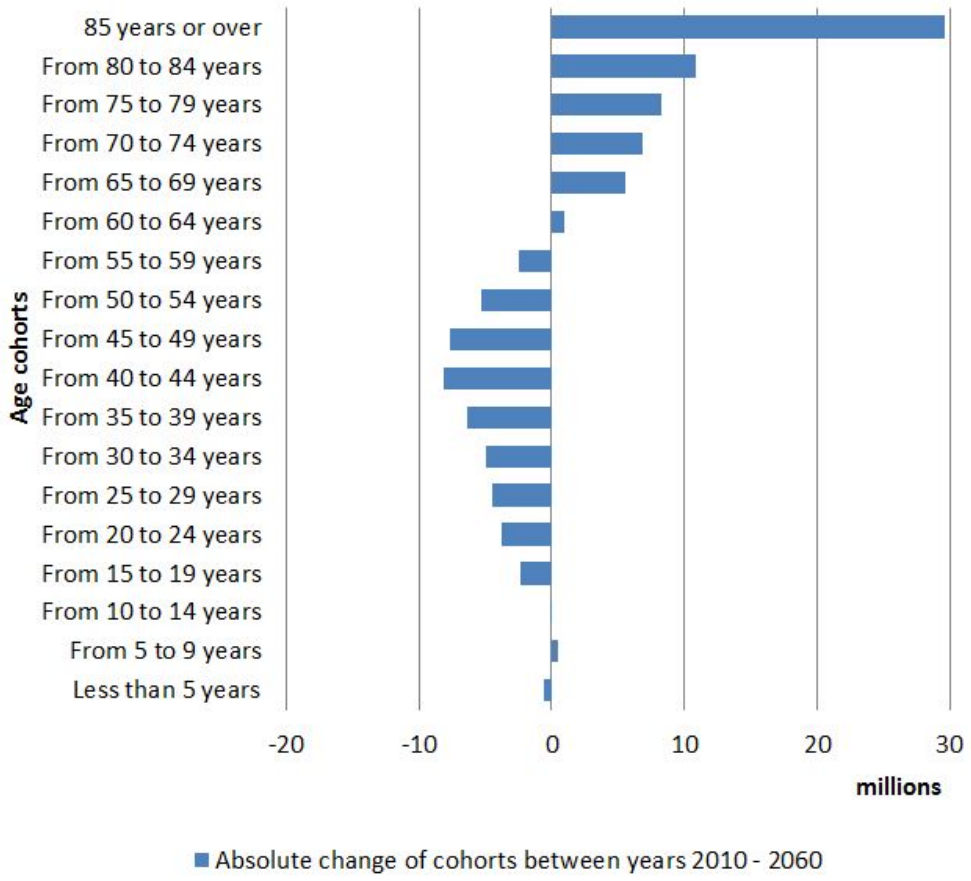
As a result of these changes, the dependency ratio will increase to 0.78 in 2080. In other words, in 2010 one average person in productive age has supported 0.5 people in non-productive age, but in 2080 this will grow to 0.78 which means growth of 54%. Increase in dependency ratio differs in individual countries. This growth is captured in figure 2.4.

Largest growth of dependency ratio is expected mostly in Eastern-European countries (Slovakia, Poland, Bulgaria, Czech Republic). For example in Slovakia, dependency ratio will grow from 0.39 to 0.91, i.e. increase is higher than whole figure in 2010. On the other side, smallest growth in dependency ratio is expected in northern countries (Latvia, Sweden, Lithuania). In Lithuania, dependency ratio will grow by 0.17 which is lowest figure in EU27.

Impact of dependency ratio to public pension expenditures can be seen in table 2.7. As we can see growth of dependency ratio will cause main instability to pension

productive age. It captures pressure on population in productive age. In this thesis we use a share of people bellow 15 and above 64 to people between 15 and 64

Figure 2.3: Absolute change of cohorts between years 2010 - 2080 in EU27



Source: EUROPOP 2013, Author's computation

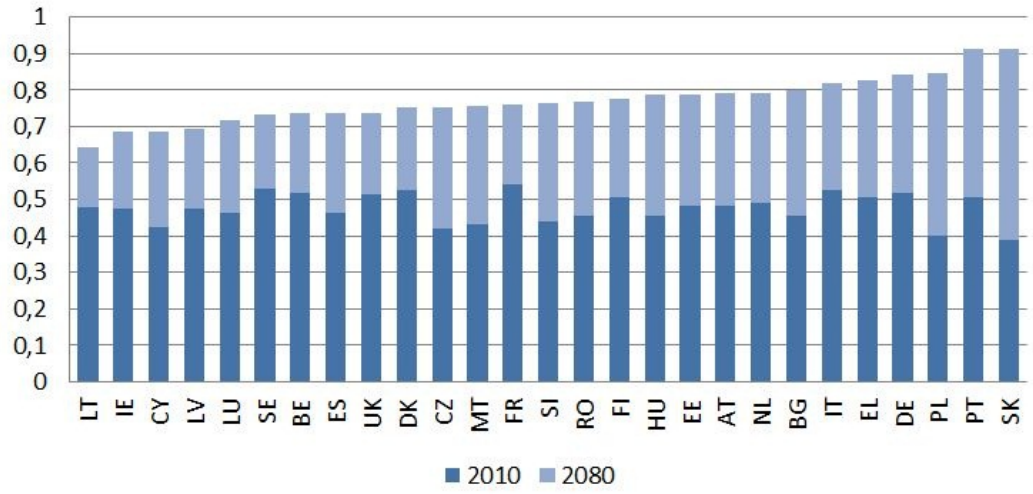
systems expenditures in the EU, in aggregate 8.5 p.p. of GDP. Growth of dependency ratio cannot be influenced by governments, while other parameters can be influenced (e.g. by increasing pension age, decreasing replacement rate etc.). It is therefore not surprising that governments will try to cut pension expenditures and mitigate the impact of dependency ratio on pension expenditures where possible.

Coverage of pension systems

Coverage ratio, defined as percentage of pensioners in population over 65 years, is decreasing. Cohort of people over 65 years will be growing in time (see subsection 2.2 for details) causing proportional growth of both numerator and denominator. On the other side, factors such increasing pension age and harder conditions to enter early retirement[35] forces people to go later in the old-age retirement, therefore the

[35]Discussed in section 2.3.1

Figure 2.4: Dependency ratio in 2010 and 2080



Source: EUROPOP 2013, Author's computation

number of pensioners relatively decreases. Coverage ratio will decrease and thanks to it the public pensions expenditures will decrease in average by 2.9 p.p. of GDP.

Employment rate

Increasing employment rates [36] is the most effective component to improve financial sustainability of pension systems (European Commission (2012a)). It decreases pension expenditures, because people work longer and dont use early retirement options. Further, because more people get a wage, it increases pension system contributions. This measure also increases GDP[37], so that pension expenditures decreases relatively to GDP even more. On average, it decreases pension expenditures by 0.8 p.p. of 2010 GDP [38]

Governments' try especially to increase female participation rate and employment rate, as the gap between male and female participation rate is large and male participation rate cannot be increased much, see figure 2.5 for details.

This is achieved mostly by equalization of conditions in labor market (e.g. decrease discrimination of females) and other social conditions (e.g. same options for both parents to enter maternity/paternity leave) for males and females. Also it is

[36]Defined as employed people over population

[37]Holds under assumption of flexible labor markets which does not have to be true in reality, see e.g. Galuščák (2001)

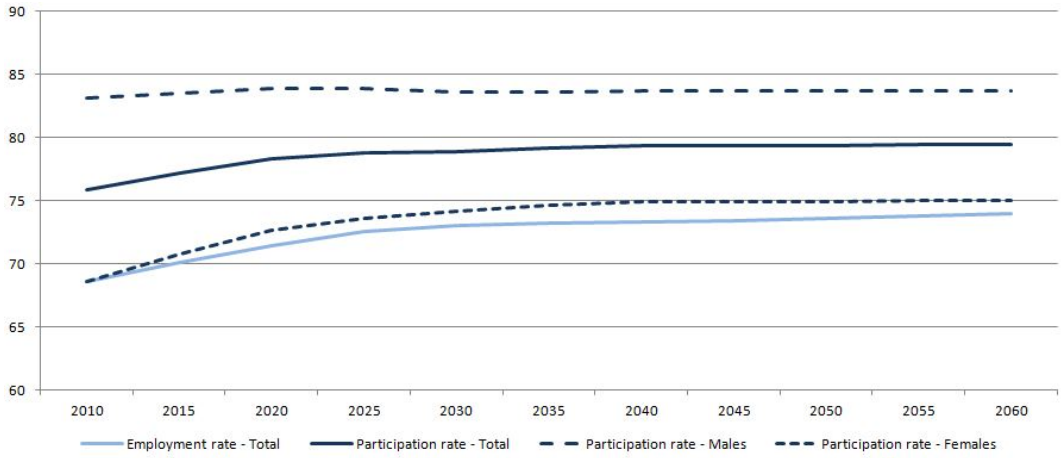
[38]Effect of GDP growth is not included in table 2.7 as it is calculated as percentage of GDP in 2010.

important that pension ages of males and females will be equalized in all EU countries[39], therefore participation of women will be increasing in time.

Benefit ratio

Benefit ratio tells us what the value of average pension is in comparison to GDP per hour worked. Again, governments seek options to decrease generosity of pension benefits[40] and will try to relatively decrease pensions. Possible options are decreasing of indexation, lower valorization, decreasing accrual rates, changing pension calculation formulas etc[41]. As a result, benefit ratio will decrease in 25 out of 27 EU countries in average by 2.5 p.p. of GDP.

Figure 2.5: Employment rate of EU27 in 2010 - 2060



Source: European Commission (2012a)

Labor intensity

Labor intensity is defined as hours worked per person. According to European Commission (2012a) it is expected that working hours per person will remain approximately the same, so it will not have any significant impact on public pension expenditures decreasing.

Giving all these trends together, we can see that public pension expenditures will grow in average by 1.6% of GDP till 2060, but the growth reaches up to 9.4 p.p. of GDP in Luxembourg (see table 2.7 for more details). As it was told, governments

[39]Discussed in section 2.3.1
[40]Current replacement rates can be found in table 2.3.
[41]Discussed in section 2.3.1

have already prepared pension systems for these trends and launched many reforms to secure sustainability of pension systems.

2.3 Pension systems reforms in the EU

"The future isn't what it used to be!"
Yogi Berra, American Baseball catcher, manager, and coach (*1925)[42]

The above-mentioned growth of pension expenditures, moreover enhanced by fiscal challenges in economic crisis, led governments to fiscal consolidation and introduction of various pension reforms. Implemented pension reforms can be divided in two groups: systemic and parametric. Systemic reforms are aimed at diversification of sources of pension income, while parametric reforms are especially helpful to decrease governments' future pension expenditures and to put pension systems on sustainable footing European Commission (2001). Parametric reforms were made mostly in first pillar, while systemic reforms in our investigation means mostly introduction of second or third pillar. Fox & Palmer (2001) has similar view on this. He lists two major trends in reforming pension systems. First, pension systems are rebuilt to strengthen the link between contributions and benefits[43], increase pension ages, and phase out special privileges. Second, partial shift to funded systems is essential, since it replaces missing human capital with real capital and through this helps to bear the costs Sinn (2000). We will elaborate more on this topic in following subsections.

2.3.1 Reforms in first pillar

Holzmann *et al.* (2001) emphasize that social insurance obligations are often the largest unreported liabilities in the public sphere. First pension pillar creates majority of these liabilities, therefore governments observe this pillar lot and reform it relatively often. These reforms can influence pension wealth dramatically. Some papers have already investigated this impact. For example, McHale (2001) and later Dušek & Kopecsni (2007) documented that PAYG pension reforms can decrease social security wealth of almost all workers in given country by magnitude of 1 to 3.5 annual average earnings.

[42]Available at http://www.brainyquote.com/quotes/authors/y/yogi_berra.html
[43]The best tool to enable this is NDC system established by few countries in Western Europe

Mostly, governments performed parametric reforms[44][45]. Together, in the EU27 there were implemented 62 parametric pension reforms in period 1993 - 2013. Extent of implemented reforms differs among countries; however 24 out of EU27 countries made at least one reform and only 3 countries did not change its system. Implemented parametric reforms consisted of combination of five typical components[46]: change of pension age, contribution rate, indexation, level of pensions or modifying conditions for early retirement. There were together 79 pension reform components implemented. Details can be found in table 2.8.

Mostly, in 67 cases, implemented components were focused on sustainability, but there were also 12 components improving adequacy of pension system, see table 2.9 for more details. Improving sustainability can be defined as either increasing income of pension system or decreasing pension expenditures in examined time period. This is mostly needed when the system is threated by lack of finance or structural or demographic pressures when there is expected increasing number of old people and decreasing number of young. On the other side, adequacy reforms increase pension expenditures or decrease income of pension system. Adequacy reforms are performed to strengthen the primary goals of pension system, i.e. mainly protecting pensioners from poverty. We will elaborate more on the implemented components in the following subsections.

Changes of pension age

Pension age influences pension expenditures very dramatically. Not only it determines the number of pensioners in individual countries (and therefore the size of pension expenditures), but it also may influences participation rate of inhabitants as it has possibility to enlarge working population and through that it can increase GDP[47] (Social Protection Committee (2013)). As a result, it decreases relative pension expenditures to GDP even more.

Changing of pension age was the most favorite component in pension reforms in the period 1993 - 2013, as it was adopted 42 times in the investigated period. In 40 cases, which makes vast majority of occurrences, the retirement age was increased and only in 2 cases it was decreased. It was in Denmark in 1999 and in Italy in 2007 (ISSA). However, these decreases were either only softening of previously

[44]The only systemic reform in first pillar was made in Sweden in 2001, where pension system was switched from DB scheme to NDC.

[45]Further, we will focus parametric reforms that are influencing majority of population (e.g. we will not consider change of contribution rate of pension of only one profession in given country, as it influences only small part of the population).

[46]Pension reform can consist of more components

[47]This works under condition of flexible labor markets which does not have to be truth in reality, see e.g. Galuščák (2001).

Table 2.8: Components of pension reforms implemented in 1993-2013

Country	Retirement age*	Early retirement	Contribution rate	Indexation	Replacement rate
AT	1	1	-	-	-
BE	1	1	-	-	-
BG	3	-	1	1	1
CY	-	-	-	-	-
CZ	4	-	-	2	-
DK	2	-	-	-	-
EE	2	-	-	-	-
FI	-	1	-	-	-
FR	2	-	1	-	-
DE	1	-	-	1	-
EL	2	1	-	-	1
HU	3	-	1	1	-
IE	2	-	1	-	-
IT	2	1	-	1	-
LV	3	1	1	-	2
LT	2	1	-	-	1
LU	-	-	1	-	-
MT	1	1	-	-	-
NL	-	-	-	-	-
PL	1	1	-	1	-
PT	-	-	1	-	-
RO	2	1	2	1	-
SK	1	1	-	1	-
SI	2	2	-	1	-
ES	1	-	-	-	-
SE	-	-	-	-	-
UK	4	-	-	-	-
EU27	42	13	9	10	5

* Includes adequate change of early retirement age
Source: ISSA, Author's analysis

implemented reforms (Italy) or simply the component was proven as unsustainable and the pension age was increased again (Denmark).

Males pension age increased in average from 63.3 to 65.9 years in the EU27 in time period 2010-2060, that is growth of 2.6 years. Usually, the pension age was increased by 2 to 5 years. In 5 countries (Austria, Belgium, Denmark, Cyprus, Finland, Portugal, Sweden) pension age did not increase. On the contrary it grew by 10 years in Czech Republic. Female pension age increased from 60.4 to 65.8 in the same period which is increase of 5.5 years. The pension age grew usually from 2 to 10 years, but there were again countries that did not change the retirement age for women (Denmark, Cyprus, Finland, Portugal, Sweden) and on the other side Czech

Republic increased pension age for females by 15 years in the mentioned period[48].

The pace of implementation differs strongly among countries. Mostly, the retirement age was not increased at once, but rather it was increased gradually by specified number of months per year which in few years resulted in proposed result (e.g. in Estonia in 2010 was legislated that starting in 2017 the retirement age will be increasing by 3 months a year until 2026, when it will reach 65 years for both males and females (ISSA)).

Eighteen countries in the EU27 have legislated a specific pension age. Seven countries have already adapted to the trend of population aging and linked their pension age to life expectancy of population, therefore pension expenditures will automatically adapt[49]. In the Czech Republic, pension age is increasing every year for 2 months (Social Protection Committee (2013)) with no limit. In Sweden participant can choose any age above 61 years as their pension age[50] (ASISP).

Present trend in increasing pension age is to equalize males and females pension age. Partly this is result of governments willing to increase participation rate of population to relatively decrease pension expenditures and partly it is caused by EU directive 79/7/EEC equalizing males and females treatment in social security (Renga *et al.* (2010)) and later EU directive 86/378/EEC equalizing pension age of males and females in occupational pension funds to further minimize differences in social security access between genders (EUROPA (2014)). In majority of countries males and females pension age

Table 2.9: Reason for implemented components in 2010-2060

Country	Sustainability	Adequacy
AT	2	-
BE	2	-
BG	6	-
CY	-	-
CZ	5	1
DK	1	1
EE	2	-
FI	1	-
FR	3	-
DE	1	1
EL	4	-
HU	4	1
IE	2	1
IT	3	1
LV	5	2
LT	3	1
LU	1	-
MT	1	1
NL	-	-
PL	3	-
PT	1	-
RO	5	1
SK	2	1
SI	5	-
ES	1	-
SE	-	-
UK	4	-
EU27	67	12

Source: ISSA, Author's analysis

[48] See table 2.10 for more details.

[49] See European Commission (2012a)for more information about this topic

[50] However, people usually choose to retire at 65 years. This trend remains stable from 1998 (ASISP)

Table 2.10: Pension age in 2010-2060

Country	2010 M	2010 F	2060 M	2060 F	Change M	Change F
AT	65	60	65	65	0	5
BE	65	60	65	65	0	5
BG	60	55	65	63	5	8
CY	65	65	65	65	0	0
CZ	60	56	70	70	10	15
DK	67	67	67	67	0	0
EE	62	57	65	65	3	8
FI	65	65	65	65	0	0
FR	65	65	67	67	2	2
DE	65	65	67	67	2	2
EL	65	60	67	67	2	7
HU	60	55	65	65	5	10
IE	60	60	68	68	8	8
IT	65	60	68	68	3	8
LV	60	55	65	65	5	10
LT	60	50	65	65	5	15
LU	65	65	65	65	0	0
MT	61	60	65	65	4	5
NL	65	65	65	65	0	0
PL	65	60	67	67	2	7
PT	65	65	65	65	0	0
RO	60	55	65	65	5	10
SK	60	57	62	62	2	5
SI	63	58	65	65	2	7
ES	65	65	67	67	2	2
SE	61	61	61	61	0	0
UK	65	60	68	68	3	8
EU27	63,3	60,4	65,9	65,8	2,6	5,5

* Pension age in 2010 (2060) according to 1993 (2013) legislation
Source: ISSA, Author's analysis

already equals and in the rest the retirement age is increasing so that it will equal in the future.

Also, many countries introduced incentives to stay longer in the workforce and vice versa. Most often incentive is set as increase of old-age pension benefit for every additional month of staying in the workforce after retirement age (e.g. Bulgaria introduced a bonus system in 2011, where retiree gets additional 2.4 % to the pension amount for every year spent in the workplace after retirement age. This mechanism works also on early retirement - reduction of 2.4% for every year missing till official retirement age (ISSA)).

Early pension

Early pension is a possibility of entering old-age retirement before acquisition of minimum required pension age. Usually, it is legislated as number of years before normal pension age, but in some countries (e.g. Portugal) it is legislated as certain age that has to be modified by government if anything changes. Also, in some countries (e.g. Italy) there is set no early retirement age and the only condition that needs to be fulfilled is to contribute in the pension system for certain time. Also, few countries have recently implemented so called corridor pensions[51] which are practically form of early retirement.

Early pension influences pension expenditures very similar as pension age does. A higher use of early pension increases number of pensioners and therefore increases pension expenditures. It also may decrease participation of inhabitants and through that decrease country's GDP (Social Protection Committee (2013)).

Age eligible for early retirement, or more precisely the time difference between early retirement age and normal retirement age, was changed 13 times in the investigated time period in the EU27. From that, eight times the change was focused on sustainability and 5 times on adequacy. Separately this may indicate that governments proposed new possibilities of early retirement, but this is not true. In 3 cases of out of 5 (in Slovakia in 2004, in Malta in 2007, and in Latvia 2000) the early retirement was introduced as compensation of increased pension age, i.e. the new early retirement age was higher than the old retirement age. Only in 2 cases (i.e. in Lithuania in 2004 and in Romania in 1995) the early retirement was introduced without any pension age growth[52].

Early retirement age does not usually influence as many people as normal retirement age, so it is usually changed at once without any gradually increments.

To enter early retirement is sometimes possible only after fulfilling given conditions. These conditions typically consist of minimum length of contribution period, number of children raised, working in hard conditions etc. These conditions differ in investigated countries, however the trend of tightening these conditions is clearly present.

In last years, there is evident trend of increasing reduction of old-age pensions when entering early retirement. This provision should demotivate people from entering early retirement and motivate them to remain in the working population. On the other side, there is still possibility to retire early in serious cases. Pensions are typically reduced by given percentage for every month missing till normal retirement age

[51] Currently implemented in Austria and Finland, in corridor pension systems there no pension age is set, but there is a certain time period where persons can retire (ISSA)

[52] See table 2.11 for details.

Table 2.11: Early retirement possibilities in 2010 and 2060

Country	2010 M	2010 F	2060 M	2060 F	Change M	Change F
AT	-8	-5	-3	-3	0	5
BE	-5	0	-3	-3	0	5
BG	0	0	0	0	5	8
CY	-2	-2	-2	-2	0	0
CZ	-3	-3	-3	-3	10	15
DK	0	0	0	0	0	0
EE	-3	-3	-3	-3	3	8
FI	-5	-5	-3	-3	0	0
FR	-5	-5	-5	-5	2	2
DE	-2	-2	-2	-2	2	2
EL	-7	-10	-5	-5	2	7
HU	0	0	0	0	5	10
IE	0	0	0	0	8	8
IT	-5	-5	-7	-7	3	8
LV	0	0	-2	-2	5	10
LT	0	0	-5	-5	5	15
LU	-5	-5	-5	-5	0	0
MT	0	0	-3	-3	4	5
NL	0	0	0	0	0	0
PL	-5	-5	0	0	2	7
PT	-10	-10	-10	-10	0	0
RO	0	0	-5	-5	5	10
SK	0	0	-2	-2	2	5
SI	-5	-3	-5	-5	2	7
ES	-4	-4	-4	-4	2	2
SE	-4	-4	-4	-4	0	0
UK	0	0	0	0	3	8
EU27	-3	-3	-3	-3	3	5

*Early pension age in 2010 (2060) according to 1993 (2013) legislation
Source: ISSA, Author's analysis

(e.g. in 2011 Bulgaria introduced pension reduction by 2.4% for every year missing till official retirement age (ISSA)).

Contribution rate

Contribution rate determines what part of individuals' gross wage is deducted for pension system purposes. In EU27 contribution rate is in average 19.4%, starting on 1% in Denmark ending at 33% in Italy. Some countries (e.g. Italy, Hungary) deduct significant percentage from wages and then finance pension system mostly by it, while other countries (e.g. France, Denmark, Portugal) rather use taxes to finance it. Pension expenditures in Denmark are financed almost solely by taxes; there is

only a small solidarity contribution 1% of gross wage. In France and Portugal, there is an additional tax which is dedicated to financing of pension system. Majority of countries has a specific contribution rate that is deducted for pension purposes, but there are also countries (Ireland, Spain, United Kingdom, Cyprus, Malta) that set only contribution rate for all government needs and government then every year decides what part of the income will be used for pension purposes.

Contribution rate also determines what part of pension expenditures will be paid by working population and what will be financed from government budget. Also, governments choose different distribution of contribution rates among employees and employers. Mostly, employer pays larger part of contribution, but there are four countries where the proportions are equivalent (Poland, Cyprus, Germany, Luxembourg) and three countries where employee pays larger part than employer (Slovenia, Netherlands, Malta) (MISSOC).

Although increasing contribution rate has impact on pension income, pension expenditures are not decreased, therefore impact on pension system deficit is not as big as in case of changing other variables. As a result, contribution rate was reformed less in comparison to previous components - only 9 times in investigated period in EU27 countries. From this total number, the contribution rate was increased 6 times and only 3 times decreased. As seen in table 2.12, the contribution rate was increased by 0.5 p. p. in average in the investigated period.

Table 2.12: Contribution rate in 2010 and 2060

Country	2010	2060	Change
AT	22,8	22,8	0,0
BE	16,9	16,9	0,0
BG	16,0	17,8	1,8
CY	10,2	10,2	0,0
CZ	26,0	28,0	2,0
DK	1,0	1,0	0,0
EE	20,0	20,0	0,0
FI	23,3	23,3	0,0
FR	15,2	15,8	0,6
DE	19,5	19,9	0,4
EL	20,0	20,0	0,0
HU	31,0	31,5	0,5
IE	10,0	10,0	0,0
IT	33,0	33,0	0,0
LV	25,3	20,0	-5,3
LT	26,3	26,3	0,0
LU	16,0	20,0	4,0
MT	15,0	15,0	0,0
NL	17,9	17,9	0,0
PL	19,5	19,5	0,0
PT	21,0	20,2	-0,8
RO	18,0	28,1	10,1
SK	18,0	18,0	0,0
SI	24,4	24,4	0,0
ES	21,2	21,2	0,0
SE	17,2	17,2	0,0
UK	19,4	19,4	0,0
EU27	19,4	19,9	0,5

Source: ISSA, Author's analysis

Indexation rules

Indexation is technique of adjusting pension income to increasing price level and through that it ensures pension benefits' purchasing power. Indexation of pensions is important because it protects pensioners from poverty. Poverty would threat pensioners if pensions re-

main the same for a long time, while inflation will rise all prices and the pension will be not sufficient to ensure minimal standard of living.

In EU27 countries, pensions growth is usually linked to prices or wage growth or its combination that occurred in the preceding year - see table 2.4 for details. Important factor is that indexation is bound by law in majority of countries. The two exceptions are Lithuania and Ireland which are not bound by law and both countries have not indexed pensions for a many years (Jankauskiene & Medaiskis (2011), OECD (2014)). It helped to decrease pension expenditures, but on the other side, pensioners in these countries have lower standard of living. From this reason, Lithuania is pushed by EU to introduce clear rules for pension indexation not dependent on political decisions (Jankauskiene & Medaiskis (2011)).

Together there were 10 changes of indexation method in EU27 in 1993 - 2013. Mostly, countries switched from wage growth indexation towards price growth (Czech Republic, Hungary, Italy, Slovakia) in comparison to 2 switches towards wage growth (Germany, Bulgaria). In this case, it cannot be said if the changes will relatively increase or decrease pensions, since this is dependent on prices and wages development. Nevertheless, there can be seen a trend to decrease number of indexation per year (Romania, Slovenia) or to perform indexation once after few years (Poland).

Level of pensions

Pension is amount of money paid monthly to all pensioners. In this case we are referring only to level of old-age pensions, since this pension is directly connected to pension systems. Level of pensions determines pensioners' standard of living. Pensioners fall below poverty level if it is to low and systems may become unsustainable if it is to high. Therefore, it is important to find trade-off between these two aspects. To protect pensioners from poverty, old-age pensions are automatically increased by indexation every year, so that purchasing power of pensions is not decreasing and continuously corresponds to current price level. In majority of countries, pensions are not allowed to decrease[53].

Together there were 5 changes disregards automatic changes caused by indexation rules. Since level of pensions is very sensitive factor influencing standard of living, decreases were performed only temporary as part of crisis austerity measures (Latvia in 2009 and 2011, Lithuania in 2010, Greece in 2011), while increases of pension level have been made only in case of poverty threat to big number of pensioners (Bulgaria in 2013).

Level of pensions is also influenced by taxes and contributions levied on pensions. At least some form of tax or social contributions is imposed on pension in majority of

[53]The only exception in the EU27 is Finland, where pensions may also decrease under given conditions

countries in the EU27, see table 2.3 for more details. However, to protect pensioners from poverty, there is usually allowance on pensions (European Commission (2012a), ISSA). These allowances cover typically more than average pensions (e.g. Czech Republic, Germany, Netherlands, Portugal), but there are also countries where it covers only lowest pensions in the country (e.g. Poland, UK).

2.3.2 Reforms in second pillar

Second pension pillar is a backbone of modern pension systems. To decrease the unfunded debt, governments have to find financing for pensions of aging population in coming decades. Therefore, they try to partially shift financial risk away from the future generations which will bear the largest burden to other generations (Fox & Palmer (2001), Schneider (2011)). Another reason for this is that it is hard to motivate people to save for retirement in first pillar, so it is easier to make them save alone. This shift is also in line with World Bank suggestions (Pordes (1994)). Problem is that transferring part of contributions from first pillar decreases revenues of the first pillar and through that increases deficits which makes the system less sustainable or even unsustainable.

Hungary was a pioneer in the EU in implementing second pillar (implemented 1998) followed by Poland. Finding the reforms relatively successful, also other countries mostly from EU10 implemented second pillar - Baltic countries, Romania, Bulgaria, Slovakia and also one country outside EU10 - Sweden. All these countries made these reforms before crisis in 2008. Last country implementing the second pillar already in crisis was Czech Republic. The oncoming crisis has tested sustainability of these reforms significantly and many countries had to partly or completely withdraw from pension reforms. Because of fiscal pressure on state budgets, governments were often forced to redirect contributions from second pillar back to first pillar, see table 2.13 for more details. Although some reforms were presented as temporary only, it is not clear whether it will be returned to original state. Unique approach was chosen in Hungary threatened by large budget deficits and later by Poland where governments nationalized whole second pillar and implemented it in underfinanced first pillar. In Sweden, Romania, Bulgaria, and Czech Republic second pillar remained unchanged in the investigated period[54].

There was not much effort to reform occupational pension funds in the EU countries (Lannoo *et al.* (2014)). Number of these funds is slightly decreasing in time because of many mergers, but number of participants is increasing every year (EIOPA (2013)).

[54]Second pillar was canceled in Czech Republic in 2014. In Slovakia, left-wing government of Robert Fico is trying to abolish second pillar as well

Table 2.13: Second pillar reversals during crisis

Country	Year of reversal	Reform implemented
Latvia	2009	Contribution to second pillar reduced by 6 p.p. and contribution to first pillar increased by same amount
Lithuania	2009	Redirection of 3.5 p.p. of contributions from second pillar to first pillar
Estonia	2009	Contributions to second pillar temporarily redirected to first pillar
Poland	2011	Contribution to second pillar permanently reduced by 5 p.p. and this was shifted to first pillar and gradually increased by 1.3% till 2017
Hungary	2011	Nationalization of second pension pillar
Slovakia	2012	Contribution to second pillar reduced by 5 p.p. and contribution to first pillar increased by same percentage
Poland	2013	Nationalization of second pillar

Source: Rudolph (2012), ISSA

2.3.3 Reforms in third pillar

As we already mentioned, third pillar enables voluntary pension savings. It is a tool enabling people to save more money for their retirement and through that improve their pension benefits. Third pillar has only minor impact on country budget[55] therefore it is not reformed as often as other two pillars.

Most frequent "reforms" regarding third pension pillar was its establishment in countries, where it previously was not available. Currently, third pension pillar is present in all countries in the EU27 except Cyprus. Much less effort was however made to reform it. The only possibility to reform third pillar was changing the incentives to save. These incentives have difficult mechanisms in individual countries (For example in the Czech Republic, government's incentives were increased by up to 50%, but contributions of participant have to be increased by 100%).

[55]Given by incentives provided by governments, see section 2.1.2.

Chapter 3

Methodology

3.1 Measuring unfunded obligations

"The purpose of science is not to analyze or describe but to make useful models of the world."

Edward de Bono, Maltese physician (*1933)[1]

Measuring of unfunded obligations was started by Feldstein (1974) in 1974 when social expenditures in both the United States and Europe increased and became regularly considerable item in government's budgets. He investigated impact of social security on individuals' simultaneous decision about retirement and saving. He defined the income from social security as the expected present value of future stream of benefits minus the expected present value of future contributions. Using this concept he expressed what amount of money the US government has to collect to cover all future benefits.

In 1990's Auerbach criticized the approach of evaluating US reforms by government's deficit, so he renewed the concept of social security wealth and introduced "generational accounting" [2] - a comprehensive framework enabling evaluation of permanent fiscal flows systems. A generational account is defined as difference between present value of all future taxes (or contributions) and present value of all future benefits for given generation. There's one account for every generation. From its definition, the sum of all generational accounts must be zero because all benefits of one generation must be paid by other one. From generational accounts researcher can see the burden falling on individual generations and demonstrate long term sustainability of such system. This framework can be used to evaluate any fiscal expenditure

[1] Available at http://www.brainyquote.com/quotes/quotes/e/edwarddebo130958.html

[2] (introduced in two studies: Auerbach *et al.* (1991) and later Auerbach *et al.* (1994))

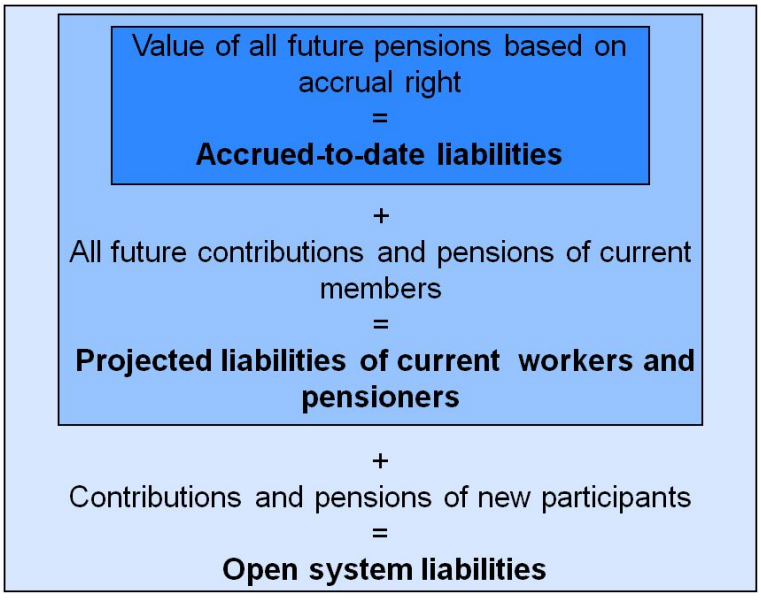
system - starting from health care (e.g. Auerbach *et al.* (1992)) ending with pension systems (e.g. Franco *et al.* (1992)).

3.2 Implicit pension debt

"I never worry about the future - it comes soon enough."
Albert Einstein, German theoretical physicist (1879 - 1955)[3]

In late 1990's Holzmann expanded the concept of generational accounting because it originally captured the effect of redistribution on individual generations as well as burden that every generation has to bear, however it was not able to capture all details of modern pension system, in particular the way it is influenced by a reform (Holzmann *et al.* (2001)). He therefore designed an actuarial mechanism that has this potential. In his studies (Holzmann (1998), Holzmann *et al.* (2001) and later Holzmann *et al.* (2004)) he proposed three forms of this mechanism: *Accrued-to-date liabilities*, *Projected liabilities of current workers and pensioners*, and *Open-system liabilities*, see figure 3.1 for details.

Figure 3.1: Relationship between definitions of IPD



Source: Holzmann *et al.* (2001), Author

[3]Available at http://www.brainyquote.com/quotes/quotes/a/alberteins106492.html

The first mentioned definition - *Accrued-to-date liabilities*, equals the present value of all future pensions to be paid on the basis of accrual rights from previous contributions. Nor future contributions, nor pensions on the basis of accrual rights from new contributions are taken into account. *Projected liabilities of current workers and pensioners* additionally contain all future contributions of current contributors and pensions stemming from these contributions. However, no new entrants in this system are allowed. These two definitions are referred to as closed liabilities, because the pension system is closed and no new entrants are allowed. Opposite to that, the *Open system liabilities* allows new entrants and through that it is able to capture longer time period. Ideally, the infinite time period would be considered, but in reality this is hard to be done, so some arbitrary time period is chosen.

All these three definitions can be labeled as IPD. From these three definitions researcher has to choose the correct definition that answers best his economic policy question (Holzmann *et al.* (2001)). First definition is useful when government chooses to immediately switch from unfunded PAYG system to a funded system (unless government defaults on its pension commitments). In this case, the government has to bear the burden of all future pensions on the basis of accrual rights and at the same time there will be no new contributions from the participants. *Projected liabilities of current workers and pensioners* are used to measure liabilities when government chooses to switch from unfunded PAYG system to funded, but there will be some delay so that PAYG system can run until last contributor dies and all pension system commitments are paid, but no new entrants are allowed. The last definition, *open-system liabilities* is chosen when we want to estimate intertemporal budget constraint, in particular financial sustainability of pension system or evaluate economic policy pension.

Especially the definition of *open-system liabilities* recorded a success in academic literature. IPD according to this definition was calculated for many countries and many countries found out that its obligations from pension system are gigantic and are even surpassing its GDP level (e.g. Silver (2008) found out that UK's IPD is 276% of GDP). Silver (2008) also suggests that government debt should be calculated as IPD because it describes state of indebtedness better than common government debt. Gokhale (2009) also adds that if IPD is ignored the government deficits will grow in future. If no action is taken, governments will have to meet its obligations by increasing taxes. According to this paper, average EU country will need to raise tax rate to 55% of national income to pay promised benefits by 2020. The later the action is performed, the higher the tax rate will have to be. Following this, Clements (2011) suggested that governments should take into account IPD implications at reforms implementation, not government debt. This was also confirmed by Beltrametti & Della Valle (2011); he says that IPD is different from government debt, and it is

meaningful to evaluate reforms using IPD.

In our analysis, we will follow Holzmann's definition of *open-system liabilities*. Holzmann *et al.* (2001) notes that to make IPDs of more countries comparable, same model for IPD estimation has to be used for all countries. This is at the same time very difficult to do, because individual countries have different pension schemes and it is therefore hard to adjust one model for all pension systems specifications. We will continue in model used by Schneider (2011) and Doležal (2012) and modify it for our needs. This would allow us to compare many countries at the cost of omitting few details that would influence IPD only slightly. We will express the model as

$$IPD = PV(Total\,contributions\ -\ total\,pension\,expenditures) = \tag{3.1}$$

$$\sum_{c=c_0}^{C}\left(\sum_{t=t_0}^{T}(N(c,t)*er(c,t)*w(t)*cr(c,t)-N(c,t)*q(c,t)*P(c,t))*(1+r)^{t_0-t}\right),$$

where c_0 is the youngest cohort in the analysis and C is the oldest cohort in the analysis. Variable t_0 represents the first period to be included in the analysis. The investigated period ends with T. $N(c,t)$ is number of people in age cohort c and time period t. Employment rate of age cohort c in time period t is represented by $er(c,t)$. $w(c,t)$ stands for average gross wage in time t. We assume no gender differential in average gross wage. From this gross wage, the contribution rate to pension system $cr(c,t)$ is deducted. In the second part of equation, we use $q(c,t)$ as probability that person gets into retirement and average annual nominal net pension $P(c,t)$. Last, but not least, we apply discounting using interest rate r.

This study aims at modeling government expenditures connected with old-age pensions[4]. Other pensions (survivor pensions and disability pensions), expenditures connected with aging population (health care expenditures) and other expenditures (e.g. connected with unemployment, families, housing) are not included in this study. Model also omits administration costs of pension system. We will not consider any provisions concerning the second pension pillar, because it may arise many new questions and doubts about how the financial and labor market would adapt, so it would bring higher uncertainty to our model. Also, deficits of pension system accumulated in past are not included in the model, so it includes only transactions in arbitrary period.

We consider only part of contribution rate that is used to finance old-age pensions. Majority of countries have designated what part of social contributions will be used for what reason (e.g. old age pension, unemployment benefits, health care). For

[4]see table 2.5 for other existing pensions.

these countries we consider only the part of contribution rate determined for old age pensions. Few countries (Cyprus, Ireland, Malta, and Spain) have however not defined use of contribution rates. In this case it is necessary to estimate the share of contributions financing this type of benefit. We will follow approach used by OECD (2011): the contribution rate will be divided in shares based on expenditures paid from its income. Further, we do not consider any subsidies, taxes or contributions paid by government into the pension system. Reasoning behind it is that at the end government will have to finance deficits anyway. Holzmann *et al.* (2001) explains, that creating debt in pension system equals to issuance of debt and this debt will have to be paid in the end from taxes anyway. In the end, financing will depend on ability of countries to collect taxes.

Average pension P (c,t) will be estimated as product of average replacement rate and average wage in given country and year. We will follow replacement rate definition as stated by OECD (2013) which defines it as a ratio of average public pension benefit in given year over the average gross wage in the economy in this year[5]. We will use replacement rate covering public pensions only. The calculated gross pension will be also reduced by potential taxes to get net pension. This net average pension will be annually increased by valid indexation rules in given country[6]. This will correspond to provisions protecting inhabitants from risk of poverty.

Probability $q(c,t)$ is estimated from pension age and effective exit age. We assume that people will retire at legislated pension age and there will be a constant share of people who enter early retirement or retire after age eligible for retirement. Pension age is therefore crucial variable for estimation of IPD. We differentiate between pension age for males and females as there are often differences which however tend to diminish in time[7]. We also consider pension age evolution in time for both genders. In some countries (e.g. Czech Republic), pension age of females still depends on number of raised children, therefore we used average number of children raised by women to estimate the pension age preciser. This measure is valid only temporarily, as a reduction of females pension age based on number of children is decreasing and approaching zero in following years. Altogether, specific pension age is assigned for both genders in every cohort for whole arbitrary period. Further, we assume constant utilization of early retirement and share of people that retire later than they are allowed by legislation. In reality, this share does not have to be constant and it can change. Especially pension reforms can have influence it as

[5]Different definitions of replacement rate are used e.g. by European Commission (2011)

[6]Also, we assume that pensions will be fully valorized by current indexation rules. This may slightly undervalue new pensions as valorization rules are slightly more generous than indexation rules, but the difference is small and it will enable calculation without making further assumptions

[7]See chapter 2 for details.

people may prefer to retire earlier because of health, working conditions etc. On the other side, there are incentives from government to retire later[8]. We assume that these factors will remain in balance therefore the share of people retiring earlier or later will remain approximately constant. Last but not least, according to Holzmann *et al.* (2004) assumptions about coverage should not affect estimates across countries. Therefore non-members, defined as persons that did not contribute at all, are not considered in the model.

From the formula it comes out that when the IPD is negative, then pension system expenditures exceed contributions in the long term and therefore it will be debt. On the other side, positive result means higher contributions that expenditures and therefore the system will be in surplus.

The IPDs estimated by our model are not forecasts. IPD estimated by our model consists of projected revenues and liabilities based on current legislation. It is probable that governments will further reform their pension systems when bigger parts of implicit expenditures becomes explicit as it is easier for government to default on their pension liabilities than pay debt (Holzmann *et al.* (2001)).

3.3 Reforms impact investigation

From the previous sections it comes out that IPD is ideal metric to estimate impact of pension reforms. In this model we will consider parametric pensions reforms that are influencing majority of population (e.g. we will not consider change of contribution rate of only one profession in given country and similar components, as it influences only small part of the population). Typical components that are implemented in reforms are changing pension age, contribution period, indexation, level of pensions and modifying conditions for early retirement. We will not consider reforms of second pillar[9]. Neither, we will not consider reforms of third pillar, as this pillar has no impact on IPD.

For every country and every investigated year (i.e. 1993 - 2013), we will create a scenario with variables needed for IPD estimation valid at that time[10] and calculate IPD based on these variables. Pension reforms will be incorporated in these scenarios, so the resulting changes of IPD between individual scenarios will be considered as impact of pension reforms to IPD.

[8] See chapter 2 for details.

[9] Reforms of second pillar make large structural changes in pension system that would need many new assumptions on labor and financial markets, therefore it would bring more uncertainty to our model. Based on that, we will leave this investigation on other studies. Impact of second pillar reforms has been already calculated by some studies, e.g. Egert (2012) who found out that implementation of second pillar has positive impact on IPD and canceling of second pillar has negative impact on IPD

[10] Pension reforms are recognized when they are implemented in the law.

We will also investigate impact of individual pension reforms components. This will be already roughly seen from the reforms' impact investigation. However, the components impact will differ between individual reforms because of various implementations (e.g. how fast will the pension age be increased) and size of changes (e.g. how many years will be retirement age increased for). To normalize these differences we will estimate the impact of individual components as potential impact, i.e. in 2013 scenario in every country we will change chosen parameter in selected way and will analyze the resulting change of IPD.

Using IPD we can investigate sustainability of pension systems. However, IPD does not say anything about fairness of the system. Therefore, we will shortly analyze fairness using redistribution of pension systems. We will analyze it for a person with average wage and average length of life who retires in analyzed year. We will calculate it as

$$Redistribution(t) = \frac{PV_t(Individual's\,average\,total\,old\,age\,pension\,income)}{FV_t(Individual's\,average\,total\,old\,age\,pension\,contribution)}$$

where FV_t means future value of contributions paid by average pensioner retiring in year t and PV_t means present value of pensions promised to average pensioner retiring in year t, where t is chosen year. The result will be displayed as percentage and will indicate what part of paid contributions an average person will get back in old age pensions, in particular, result of 100 means that average pensioner retiring in time t will get 100% of old age contributions back in form of old-age pension. Number 110 means that average pensioner retiring in time t gets 10% more money than he contributed and 90 means that he will get less than he contributed. Using these methods we will be able to analyze impact of reforms from two perspectives.

Chapter 4

Data description and sources

"The past is certain, the future obscure."
Thales, pre-Socratic Greek philosopher (635 BC - 543 BC)[1]

In this chapter we will present data using which our model will be calculated. It is clear that the model outcome is as good as the data and assumptions behind it. Therefore, we will have a closer look on data we use. To make estimations of IPD comparable, we use consistent data covering whole EU27. Largest part of data is the labor force projection presented in the following subchapter. In the next subchapter we will present the rest of used data and assumptions behind the model.

4.1 Population forecast

The most important part of data in our model is population forecast. The forecast employed in our model is EUROPOP 2013 study created by European Commission. It is estimated from present population data based on "convergence trend" of three main factors among EU countries: fertility, mortality, and net migration. Obtained forecasts comprise various statistical information (e.g. life expectancy forecast, population forecast) on national level for all EU and EFTA countries based on years and genders. Most importantly, data contains 1st January population forecast for years 2013 - 2080 by age and sex. EUROPOP 2013 contains four variants of prognosis differing in assumptions. In our analysis we use the main scenario considering net migration[2].

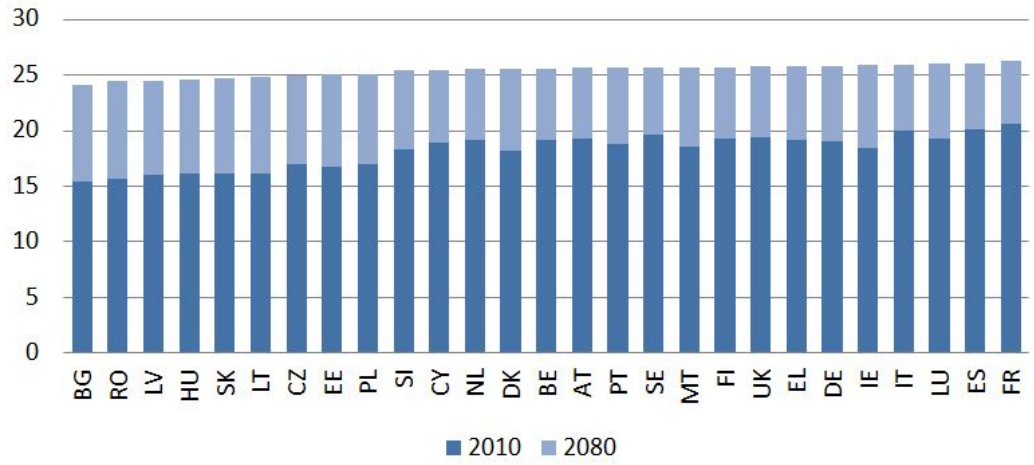
[1] Available at http://www.quotationspage.com/quote/29196.html

[2] For more information about EUROPOP 2013 see http://ec.europa.eu/eurostat/cache/metadata/en/proj_13n_esms.htm

Trends presented in this dataset are already introduced in chapter 2.2. In few words, the dependency ratio will increase from 0.5 in 2010 to 0.78 in 2080. In particular, this will be caused by fact that population in productive age will be shrinking and on the other side the population in post-productive age will increase, see figure 2.3.

From the same source, we use also data treating life expectancy, in particular forecast of life expectancy at 65 years. It treats again time period of 2013 to 2080. In this period, the life expectancy will increase in all countries in the range from 5.5 in Bulgaria to 8.8 in France, see figure 4.1. As a result, life expectancy will be the lowest in Bulgaria at 24.2. Longest life of 26.3 years after 65 can be expected by people in France.

Figure 4.1: Life expectancy at 65 years in 2010 and 2080



Source: EUROPOP2013, Author's computation

For other prognoses relating population and labor markets (e.g. employment rate forecast) we use statistical annexes of Ageing report 2012[3]. It contains employment rate, participation rate, and effective exit age prognoses.

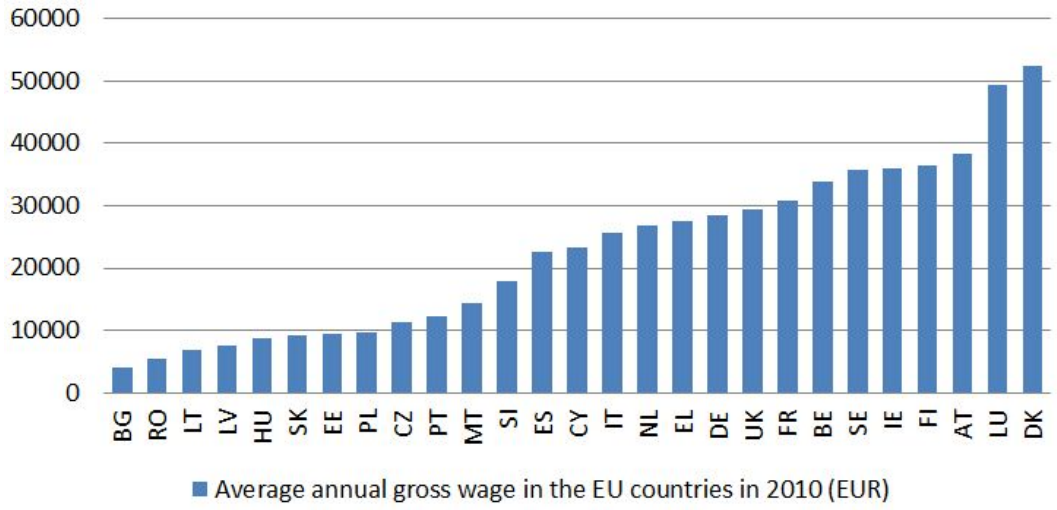
In our model, we will incorporate only population born before 2016. The last generation born in 2015 will therefore reach the threshold of population prognosis of 2080 in 65 years. In the following years, we will follow Holzmann *et al.* (2004) and estimate their future life with life expectancy at 65 years.

[3]available at http://ec.europa.eu/economy_finance/publications/european_economy/2012/2012-ageing-report_en.htm

4.2 Other variables used in the model

To produce comparable estimates of IPD, we would further need consistent data of average wages in individual countries. These data were downloaded from KILM database[4] provided by International labour organization (ILO). It provides consistent data of average annualized gross wages among all EU27 countries[5] in local currencies[6]. In figure 4.2 we can see gross average wage in individual countries at the start of investigated period. There is no forecast on wage evolution in EU27 countries, therefore we assume a 3% growth in this model consisting of 2% inflation and 1% real growth.

Figure 4.2: Average annual gross wage in the EU countries (EUR)



Source: ILO, OECD

Share of people utilizing early retirement and retiring later than at legislated pension age is estimated from effective exit age data downloaded from Ageing report 2012. This source includes national data on age when average person leaves working population. Based on these data and legislated pension age we can estimate what share of people in given year use the possibility of early retirement or retire later than legislated.

Last, but not least, we will normalize all IPDs using 2010 GDP data from Eurostat.

[4]Information about this database can be found on http://www.ilo.org/empelm/what/WCMS_114240/lang–en/index.htm

[5]Denmark provided data for private sector only, therefore we used number from OECD for Denmark capturing both private and public sector

[6]To convert these data into EUR we use average exchange rate in 2010 provided by OANDA.

4.3 Macroeconomic assumptions

Our model is strongly determined by macroeconomic assumptions on the background of the model. Holzmann *et al.* (2001) says that the most important economic assumptions influencing the accrued pension liabilities are the real interest rate, real wage growth, inflation rate, and survival probabilities. Assumed real wage growth and inflation was already mentioned in chapter above. We will consider inflation of 2%, since this is a long term target of inflation for ECB and other central banks, (e.g. UK and CZ) and at the same time other central banks are close to this threshold (e.g. HU 3% and Poland 2.5%) (Cempírek (2013)). As a consequence, assume growth of gross nominal wages of 3% consisting of inflation of 2% and 1% real wage growth[7].

All accrued liabilities are discounted using discount rate in our model. Soto *et al.* (2011) remarks that accrued liabilities depend strongly on the chosen discount rate. He says that the higher discount rate, the lower the final IPD is. We use discount rate of 3% as real interest rates over last 50 years were close to this number in the EU member countries[8].

4.4 Legislation of pension systems

Parameters representing local pension systems legislation in our models are the key part of our model. Major source of this data was ISSA database[9]. It includes both description of current pension system as well as list of all reforms in pension system in all EU countries. Every reform is clearly described and all the changes are entered into model scenarios. In case that some data were missing or were unclear, we used MISSOC database or ASISP reports.

[7]How accrual pension liabilities changes with varying real wage growth can be seen e.g. in Bezděk (2000)

[8]See European Commission (2011) for more details

[9]Available at http://www.issa.int/country-profiles;jsessionid=36FD268B79A509908C9940266249C823

Chapter 5

Empirical results

"My interest is in the future because I am going to spend the rest of my life there. "
Charles F. Kettering, American inventor (1876 - 1958)[1]

In this chapter we will present results of our model. First we will describe impact of pension reforms to IPD, investigate sensitivity of results to change of macroeconomic assumptions and compare the results to similar studies. Further, we will investigate what is the possible reduction of IPD by typical pension reforms components. These results will be then confronted with redistribution changes caused by pension reforms as an measure of fairness of pension systems to show the overall impact of the reforms.

5.1 Impact of pension reforms to IPD

This section presents impact of pension reforms to IPD of individual countries. First of all we will present estimated IPDs of individual countries. Based on these result, we will proceed to pension reforms impact calculation. Sensitivity of these results to chosen macroeconomic assumptions will be tested using sensitivity analysis.

5.1.1 Implicit pension debt

First of all, let us briefly repeat what is the definition of the IPD; it is a difference between discounted future pension contributions and discounted future pension expenditures. According to Holzmann *et al.* (2001) it is amount of money that government should own to cover all future liabilities based on accrued rights of pension

[1] Available at http://www.brainyquote.com/quotes/quotes/c/charlesket163122.html

system participants. Alternatively, it can be understand as amount of money that governments will have to pay from its own sources, e.g. collect by taxes.

Table 5.1 shows the evolution of IPD for individual countries as well as aggregated number of EU27 countries.

As we can see, IPDs are significantly high in majority of EU27 countries in last investigated year, i.e. 2013. The level of accrued liabilities reach cumulatively 334% of GDP in EU27 countries[2]. The lowest figures can be found in Denmark and Cyprus. In Cyprus, the IPD is seven-times higher than its GDP in 2010 given especially by low contributions from participants. However, the highest debt was recorded in Denmark, where the IPD reached 1,128 % of GDP. Denmark's IPD is high because it finances its pension system almost solely by taxes [3]and majority of acrued liabilities is beared by government. Figures from opposite end of the scale are recorded by Lithuania, Czech Republic, Hungary, Romania, and Ireland. In Lithuania with 76% and Czech Republic with 47%, the IPD is even positive which means that future accrued liabilities are smaller than future contributions. These numbers are however not sustainable in the future. In Lithuania, low IPD is mostly caused by absence of indexation and valorization rules[4] in combination with ungenerous system settings which is not sustainable in the long term and old-age pension will have to be increased in the future. In Czech Republic, this is caused by increasing pension age by 2 months per year without any limit causing it to reach almost 74 years in 2080, while the life expectancy in 2080 reaches 88 years. Moreover, the pension age increases at faster pace in comparison to life expectancy. Combination of these facts decreases period spent in old-age retirement to minimum which moreover tend to disappear in the future. This state is not sustainable and Czech government already plans to cap the pension age at some reasonable age[5] (Hovorka (2014)). Small liabilities were recorded by Hungary (-20%), Romania (-54%), and Ireland (-67%).

[2]Weighted average of EU27

[3]Denmark it has contribution rate only 1%

[4]Up to date, Lithuania did not even indexed their pensions in the past years (ASISP) and EU already warns it from decreasing pensioners standard of living (European Commission (2012c)).

[5]Current political debates speak about 65 yearsHovorka (2014).

Table 5.1: IPD evolution based on legislation in given years (% of GDP)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT	-659%	-659%	-659%	-659%	-659%	-659%	-659%	-659%	-659%	-659%	-659%	-659%	-415%	-415%	-415%	-415%	-415%	-415%	-415%	-415%	-415%
BE	-428%	-428%	-428%	-428%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-348%	-348%
BG	-432%	-432%	-432%	-432%	-432%	-432%	-432%	-374%	-374%	-374%	-374%	-374%	-374%	-374%	-374%	-374%	-374%	-374%	-298%	-298%	-288%
CY	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%	-749%
CZ	-159%	-159%	-159%	-67%	-67%	-67%	-67%	-67%	-67%	-280%	-199%	-199%	-199%	-199%	-199%	-199%	-199%	-134%	29%	29%	47%
DK	-1107%	-1107%	-1107%	-1107%	-1107%	-1107%	-1211%	-1211%	-1211%	-1211%	-1211%	-1211%	-1211%	-1128%	-1128%	-1128%	-1128%	-1128%	-1128%	-1128%	-1128%
EE	-373%	-373%	-373%	-373%	-373%	-264%	-264%	-264%	-264%	-264%	-264%	-264%	-264%	-264%	-264%	-264%	-264%	-210%	-210%	-210%	-210%
FI	-420%	-420%	-420%	-420%	-420%	-420%	-420%	-420%	-420%	-420%	-420%	-420%	-363%	-363%	-363%	-363%	-363%	-363%	-363%	-363%	-363%
FR	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-554%	-474%	-474%	-463%
DE	-252%	-252%	-252%	-252%	-252%	-252%	-252%	-252%	-252%	-526%	-526%	-526%	-526%	-526%	-447%	-447%	-447%	-447%	-447%	-447%	-447%
EL	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-990%	-782%	-782%	-782%	-514%	-514%	-420%
HU	-460%	-460%	-351%	-351%	-263%	-263%	-263%	-263%	-263%	-263%	-256%	-256%	-256%	-256%	-256%	-256%	-20%	-20%	-20%	-20%	-20%
IE	-226%	-226%	-226%	-226%	-226%	-226%	-226%	-226%	-226%	-226%	-226%	-114%	-114%	-114%	-114%	-114%	-114%	-114%	-67%	-67%	-67%
IT	-860%	-860%	-860%	-860%	-860%	-860%	-860%	-860%	-401%	-401%	-401%	-336%	-336%	-336%	-345%	-345%	-345%	-160%	-160%	-160%	-160%
LV	-324%	-324%	-324%	-305%	-305%	-305%	-305%	-249%	-249%	-249%	-249%	-249%	-249%	-249%	-249%	-249%	-246%	-246%	-243%	-173%	-173%
LT	-87%	-87%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	26%	76%	76%
LU	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-575%	-504%
MT	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-364%	-282%	-282%	-282%	-282%	-282%	-282%	-282%
NL	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%	-451%
PL	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-386%	-379%	-379%	-379%	-379%	-379%	-271%	-271%	-271%	-141%	-141%
PT	-300%	-300%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%	-311%
RO	-369%	-369%	-384%	-384%	-116%	-116%	-116%	-116%	-116%	-116%	-116%	-116%	-113%	-113%	-113%	-113%	-113%	-113%	-54%	-54%	-54%
SK	-548%	-548%	-548%	-548%	-548%	-548%	-548%	-548%	-548%	-548%	-548%	-315%	-315%	-315%	-315%	-315%	-315%	-315%	-315%	-315%	-315%
SI	-588%	-588%	-588%	-588%	-588%	-588%	-588%	-506%	-506%	-506%	-506%	-506%	-506%	-506%	-506%	-506%	-506%	-506%	-506%	-506%	-366%
ES	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-251%	-179%	-179%	-179%
SE	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%	-515%
UK	-414%	-414%	-303%	-303%	-303%	-303%	-303%	-303%	-303%	-303%	-303%	-303%	-303%	-213%	-213%	-213%	-213%	-208%	-208%	-208%	-202%
EU27	-474%	-474%	-457%	-456%	-451%	-451%	-453%	-453%	-395%	-453%	-452%	-441%	-434%	-420%	-405%	-401%	-396%	-371%	-344%	-339%	-334%

Note: We use following convention: Negative number means debt, while positive means surplus.
Source: Author's analysis

These results correspond to studies that calculated IPDs of these countries previously. Bellow in table 5.2 we present studies written after 2000[6] dealing with IPD in EU countries.

Table 5.2: Comparison of IPD with similar studies(% of GDP)

	Obořil (2015)	Kaier (2013)	Doležal (2012)	Schneider (2011)	Soto (2011)	BFIS (2008)	Holzmann et al. (2004)	
d.r.	3	3	3	2	1	3	2	4
AT	-415%	-360%				-232%		
BE	-348%		-160%			-208%		
BG	-288%	-202%	-238%		-3%			
CY	-749%							
CZ	47%	-201%	-47%	-55%				
DK	-1128%							
EE	-210%		-128%	-56%	58%		-268%	-189%
FI	-363%	-301%				-200%		
FR	-463%	-362%				-237%		
DE	-447%	-330%				-207%		
EL	-420%	-231%	-906%					
HU	-20%	-257%	-89%	-111%	-27%		-300%	-203%
IE	-67%					-110%		
IT	-160%	-323%	-481%			-257%		
LV	-173%	-125%	-71%		82%			
LT	76%	-180%	-96%		22%		-221%	-155%
LU	-504%					-211%		
MT	-282%						-356%	-234%
NL	-451%	-236%				-149%		
PL	-141%	-361%	-270%	-234%	-101%		-379%	-261%
PT	-311%	-299%				-246%	-358%	-233%
RO	-54%		-198%		-76%		-386%	-256%
SK	-315%	-211%	-250%	-87%	-25%		-304%	-210%
SI	-366%		-298%			-228%	-429%	-298%
ES	-179%	-204%	-117%			-186%		
SE	-515%	-284%						
UK	-202%					-128%		

Source: Cited studies, Author's analysis (d.r. stands for discount rate)

Comparison of absolute numbers between these studies is very difficult, if not impossible because of different methodologies, data, macroeconomic assumptions and discount rates. Methodology, we use, is very close to Holzmann *et al.* (2004) however there are certain differences, in particular we use indexation rules as applied by individual countries to show impact of its changes while Holzmann uses unified

[6]There are also older studies that deals with IPD (e.g. Kuné (2000), Gomulka (2000), Kune (1996), Chand & Jaeger (1996), Mussa & Masson (1995), Kuné & Pinxt (1993), Van den Noord & Herd (1993)) however these analysis are already old to compare results with this study

indexation for all countries. This causes significant differences for countries that do not use any indexation rules (Lithuania, Ireland) or use indexation different from indexation method chosen by Holzmann (Hungary, Romania). There are also differences in data, especially in arbitrary time period and base year. As we can see from the table, because of similar methodology also the results of Holzmann's study are very close to our study. Other studies differ in methodology (e.g. Soto *et al.* (2011), Schneider (2011)), base years and population prognosis[7] (All mentioned studies), inflation assumed (e.g. Schneider (2011)) or utilization of pension formulas and wage profiles (e.g. Schneider (2011)).

On the other side, there are some common features that can be seen. Most importantly, IPD reaches significant amounts in all investigated countries and through that we are confirming previous studies. Confirming Soto *et al.* (2011) we can see that discount rate influences total accrued liabilities significantly. The higher discount rate is applied, the lower is resulting IPD.

5.1.2 Impact of pension reforms to IPD

In previous chapter we have described what the IPDs are in individual countries in year 2013. As pension system legislation in every country evolves, the IPD evolves with it. In table 5.1 we have estimated IPD for individual countries based on variables legislated in investigated years. We will now have a look at what was the impact of investigated pension reforms. In table 5.1 we can see the evolution of IPDs for individual countries in investigated time period estimated using variables valid in given year. As we can see, the consolidated level of IPD in EU27 is decreasing from -474% in 1993 to -334% in 2013, i.e. decrease of accrued liabilities by 140% of GDP. This can be explained by fact that larger parts of implicit pension debt become explicit and governments are therefore putting more effort into reforming pension system.

There can be found countries that decreased its IPD, but there are also countries that did not change the level of accrued obligation at all. Few countries did even increased its level. This is case of Portugal, Denmark, and Germany which increased its accrued liabilities. In Portugal, government performed only one pension reform in investigated period[8] implementing decrease of contribution rate paid by employers by 0.75%. In Denmark, original pension age of 67 was firstly decreased from 67 to 65, however because of unsustainability of pension systems after this reform the pension age was again gradually increased to 67[9]. In Germany, increase of debt by 195%

[7] Assuming population with increasing dependency ratio in time, the longer prognosis we take into account, the larger IPD occurs (Soto *et al.* (2011))

[8] Main reform of pension systems came in 2014 according to ISSA

[9] The increase of IPD was caused by gradual implementation of new pension age.

of GDP was mainly caused by proposed change of indexation from price to wage which under our model assumptions increased accrued liabilities by 273% of GDP, i.e. more than double of previous level. In Netherlands, Cyprus, and Sweden, no pension reforms were performed therefore the IPD remained the same in investigated period.

On the other side, majority of countries (i.e. 21 countries out of 27) have decreased its accrued pension liabilities in investigated period. Largest part of initial IPD was cut in southern countries - in Italy and in Greece where previously generous pension systems implied large accrued liabilities. As a result, pension systems of these countries facilitated largest pension reforms and through that largest reduction of IPD. In Italy, IPD was reduced by 700% of GDP in the investigated period and in Greece by 570% of GDP. In Italy, the largest reduction was performed using change of indexation from wage to inflation from previous year, restricting possibilities of early retirement from 60 years (55 for women) to 61 years for both genders and through increasing pension age from 65 years (60 for women) to 68 years and 4 months. In Greece even larger reforms were performed because of financial aid from the EU. Since outbreak of the crisis, Greece was forced to increase retirement age to 67 years and especially limit usage of widely used early retirement by increasing minimum retirement age from 50 to 62 years. Moreover, since all these reforms were not able to decrease budget deficit to the required level, all pension were cut by 10% and subsequently frozen till 2015. Combination of these reforms helped to reduce IPD by 570% of GDP. In Hungary, the evolution of GDP was even more dramatic. After initial increasing of

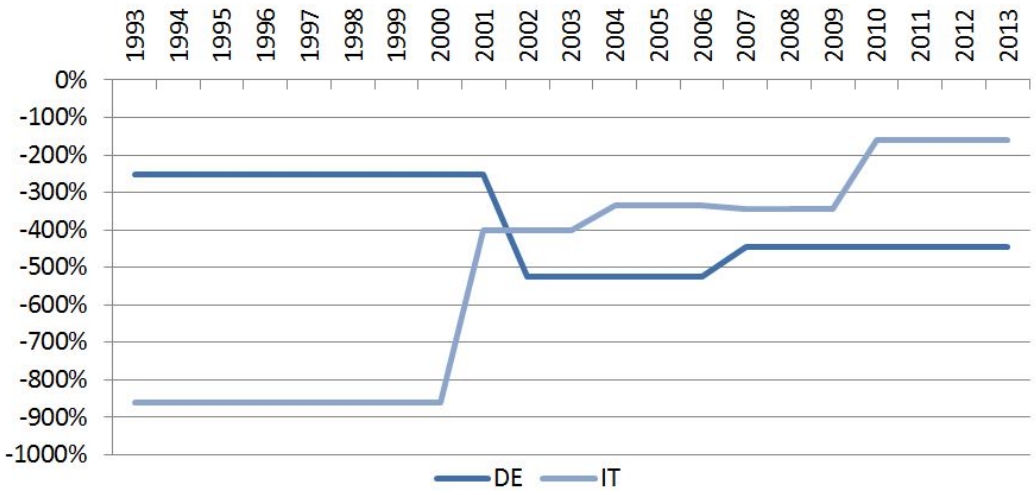
Table 5.3: Comparison of IPD reduction with similar studies

	Oboril (2015)		Soto (2011)	
	IPD	Change	IPD	Change
AT	-659	244		
BE	-428	80		
BG	-432	144	-148	145
CY	-749	0		
CZ	-159	205		
DK	-1107	-21		
EE	-373	163	-35	94
FI	-420	57		
FR	-554	91		
DE	-252	-194		
EL	-990	570		
HU	-460	440	-181	154
IE	-226	159		
IT	-860	700		
LV	-324	151	31	51
LT	-87	162	-58	81
LU	-575	72		
MT	-364	81		
NL	-451	0		
PL	-386	245	-331	230
PT	-300	-10		
RO	-369	315	-192	115
SK	-548	234	-184	159
SI	-588	222		
ES	-251	71		
SE	-515	0		
UK	-414	212		

Source: Cited study, Author's analysis

pension age (from 55 years for women, respectivelly 60 for men) to 62 years, second pillar was introduced which raised payments (hence contribution rate) to pension system. After few years, the second pillar was nationalized which had two consequences.

Figure 5.1: Comparison of IPD evolution of Italy and Germany (% of GDP)



Source: Author's analysis

Firstly, the government acquired money accumulated in second pillar for the first pillar. Secondly, the contributions originally intended for second pillar were redirected to first pillar, therefore this reform even increased sustainability of fist pillar. In addition, after nationalization of second pillar, pension age was increased again to 65 and indexation was changed. Original linkage to wages and prices in equal proportions was changed to combination of prices and wages depending on GDP growth[10]. In Romania, reduction of IPD was caused purely by increasing pension age from 55 for women and 60 for men to 65 for both genders and by increasing contribution rates from 18% to 27.6 % of gross wage. In figure 5.1 we can see comparison of Italy as the best performer and Germany as the worst performer in IPD reduction.

There exists not much literature dealing with this topic. Moreover, from the similar papers none is investigating this impact in such extent. The most similar

[10]Indexation in Hungary depends on GDP growth as follows: When GDP growth is 3 percent or less, indexation will reflect increases in prices. When GDP growth exceeds 3 percent, indexation will be based on increases in both prices and wages, respectively, in the following proportions: 80 percent to 20 percent for growth between 3 and 4 percent; 60 percent to 40 percent for growth between 4 and 5 percent; and equal proportions of 50 percent for growth exceeding 5 percent.

paper is written by Soto *et al.* (2011). This paper examines what is the long term effect of pension system diversion and therefore he employs IPD. It estimated IPD in present year and IPD before parametric reforms[11] Results of this study as well as comparison with result of our paper can be found in table 5.3.

It is difficult to compare results of these two studies. Firstly, IPDs calculated by individual papers are different. We have already outlined differences in methodology in section 5.1.1. To summarize them, Soto *et al.* (2011) employed estimations from European Commission (2009) to calculate IPD. Further, he was using shorter time period (2060 in comparison to 2080) and different discount rate (1% versus 3%). As a result, reduction of IPDs can be higher in our paper, since it is calculated as difference between two higher IPDs in individual years. Secondly, Soto *et al.* (2011) wrote his paper 4 years earlier resulting in absence of some pension reforms in his investigation resulting in differences between the two papers. Considering these facts, it can be said that our paper confirmed results of Soto *et al.* (2011) as reduction of IPD in both cases was substantial.

5.1.3 Potential impact of individual pension reforms components

In previous sections we have shown total impact of pension reforms to IPD. Every pension reform that we investigated consists of various components. We have outlined the typical components of pension reforms in chapter 2. In this section we will show the impact of these individual components to IPD.

As it was already told in chapter 2, pension reform usually changes Retirement age (RA), Early retirement age (ERA), Indexation (IN), Replacement rate (RR), and/or Contribution rate (CR). Impact of these components on IPD depends on population structure and pension system parameters that are varying among countries. Also, speed of implementation determines impact of these components to IPD a lot. The impact is larger when the reforms are implemented immediately. The more gradually the components are implemented, the smaller impact they have.

Previous features make investigation of impact to IPD difficult. To avoid analysis of individual components, make difficult normalizations for speed of implementation and size of change, and then average the impacts, we will rather investigate potential impact of individual components. In every country, we take the scenario based on legislation from year 2013 and in this scenario we increase the investigated variable by chosen value in whole period and will study its impact. The results will therefore

[11]Exact time period is however not specified. Author mentions only that the period took 20 years however not initial neither final year of the period is mentioned.

not show real impact of individual components, but rather potential impact when modifying chosen variable. Results of this analysis can be found in table 5.4.

Table 5.4: Potential impact of individual components implemented in reforms in EU27 (% of GDP)

	IPD	Change of IPD				
	Base	cr+1	ind-0.1	rr-1	era+1	re+1,era+1
AT	-415%	24%	36%	20%	47%	58%
BE	-348%	22%	28%	18%	41%	42%
BG	-288%	13%	18%	12%	0%	30%
CY	-749%	28%	44%	17%	28%	53%
CZ	47%	18%	16%	11%	5%	43%
DK	-1128%	30%	49%	25%	0%	53%
EE	-210%	15%	19%	13%	0%	32%
FI	-363%	23%	34%	19%	50%	55%
FR	-463%	21%	29%	15%	44%	44%
DE	-447%	19%	32%	19%	41%	45%
EL	-420%	23%	34%	22%	33%	52%
HU	-20%	16%	19%	12%	0%	41%
IE	-67%	21%	0%	5%	0%	21%
IT	-160%	20%	29%	16%	9%	57%
LV	-173%	13%	14%	9%	0%	28%
LT	76%	10%	0%	4%	0%	17%
LU	-504%	18%	37%	16%	45%	45%
MT	-282%	17%	20%	15%	28%	31%
NL	-451%	17%	31%	16%	0%	40%
PL	-141%	19%	18%	13%	0%	37%
PT	-311%	14%	21%	11%	1%	34%
RO	-54%	14%	15%	11%	2%	32%
SK	-315%	13%	21%	13%	3%	30%
SI	-366%	21%	35%	22%	0%	52%
ES	-179%	20%	23%	14%	3%	42%
SE	-515%	24%	41%	23%	2%	51%
UK	-202%	26%	27%	15%	0%	49%
EU27	-334%	21%	28%	16%	21%	46%

Source: Author's analysis

Increasing pension age has the largest impact to IPD from investigated components. On aggregate level, increasing retirement age by 1 year[12] decreases IPD by 46% of GDP[13]. IPD reduction does not vary dramatically in individual countries - it is always in range starting with 17% ending with 58%. Moreover, as stated already in chapter 2, this component can also increase participation of inhabitants and

[12]This change also includes increasing early retirement age so that period of early retirement remains the same

[13]Schneider (2011) investigated this impact on 4 countries and estimates this impact on 25-34%.

through that theoretically increase GDP[14], therefore the reduction of IPD could be even larger[15].

Change of indexation has second largest impact to IPD - decreasing indexation by 0.1% can decrease IPD by 28% of GDP in the EU and by similar figures in all European countries[16]. Unfortunately, since indexation is linked to chosen variable (changes in wages, prices, or combination) it is impossible to decrease it directly and its impact cannot be precisely estimated. It is only possible to change variable to which indexation is linked. As wages usually grow faster than prices (e.g. Johnston (2012) or United states government accountability office (2005)), change of indexation from wages to prices can bring significant IPD reduction.

Increasing early retirement age (or limiting early retirement possibility at all) has smaller effect in comparison to previous components - on aggregate level increasing early retirement age[17] by 1 year decreases IPD by 21% of GDP on EU27 level. The difference from impact caused by increasing pension age is given by absence of early retirement in some countries[18] and not full utilization in all relevant countries[19]. On the other side, in countries with high utilization of early retirement, impact of increasing early retirement age almost correspond to impact of increasing normal pension age (e.g. Belgium, France, Finland).

Same impact on IPD on aggregate level was also caused by increasing contribution rate by 1 p.p. - 21% as in previous case. The figures of individual countries are relatively balanced in range from 10% in Lithuania to 30% in Denmark.

Last, but not least, reducing replacement rate by 1 p.p. decreases IPD by 16% of GDP at the aggregate level. The figures of individual countries are again relatively balanced in range from 4% in Lithuania to 25% in Denmark.

5.1.4 Sensitivity analysis

"Prediction is very difficult, especially if it's about the future."
Niels Bohr, Danish physicist (1885 - 1962)[20]

In previous section we have investigated impact of reforms as well as individual pension reform components to IPD. These results are based on assumptions described

[14]Holds under assumption of flexible labor markets which does not have to be truth in reality, see e.g. Galuščák (2001)
[15]This effect was not investigated.
[16]In Ireland and Lithuania is not possible to decrease inflation since inflation is not bound by any rules therefore equals zero. See chapter 2 for details.
[17]In countries where it is possible
[18]See chapter 2 for details
[19]See chapter 2 for details
[20]Available at http://www.brainyquote.com/quotes/quotes/n/nielsbohr130288.html

in chapter 3. However, world is changing and future evolution of variables may differ from our assumptions. Any adjustment of these variables will change the final impact of pension reforms to IPD. In this section we will analyze how the impact of pension reforms changes when we modify input assumptions.

From this reason, we have created 5 different scenarios that will examine sensitivity of previous results to changes of basic assumptions. Table 5.5 describes those five scenarios.

Table 5.5: Scenarios to analyze sensitivity of previous results

	Inflation	Wage growth	Discount rate	Employment rate	Legislation
Baseline	2	3	3	EU	Current
Optimistic	2	3	3	11/10 * EU	Current
Pesimistic	2	3	3	9/10 * EU	Current
Economic stagnation	0	0	2	EU	Current
Economic growth	3	4	3	EU	Current

Baseline scenario serves as best guess under assumption of no policy change as values in this scenario are the long-term goals (e.g. inflation) or long-term historical average values (e.g. discount rates). Further, we have created *Optimistic* and [21] scenario examining sensitivity to change of employment rate. This change can occur e.g. by increasing willingness of people to work till higher age (especially after pension age), establishing more flexible working market enabling higher participation or decrease of unemployment. We consider increase of the base employment rate by 10% and decrease by 10%. Other two scenarios are called *Economic growth* and *Economic stagnation*. They test sensitivity to changes of inflation, discount rate, and wage growth. We have chosen typical values that appears in these economic cycles - we decreased inflation and wage growth as well as discount rate in *Economic stagnation* and made the opposite modification in the *Economic growth* scenario. Except stated changes, no other modifications were made, i.e. legislation remains the same across all scenarios, no changes were made also to population prognoses. It holds that the higher the wage growth and inflation, the higher the accrued libilities will be. Partly it will be caused by fact that higher wages means generally higher pension benefits and also indexation and valorisation of pension benefits will be higher. On the other side, the lower the wage and price growth, the lower also implied IPDs will be. Lower initial and final debts mean also smaller differences between them. Impact of pension reforms under these five scenarios can be found in table 5.6.

As we can see, scenarios influence the impact in various ways. Scenarios *Economic growth* and *Economic stagnation* influenced the impact significantly - scenario *Economic growth* increased the IPD impact from 140% to 202%, i.e. by 62% of GDP

[21] Pessimistic

Table 5.6: Sensitivity of reforms' impact to IPD on change of assumptions (% of GDP)

	Change of IPD in 1993 - 2013				
Code	Baseline scenario	Economic growth	Economic stagnation	Optimistic	Pessimistic
AT	244%	351%	157%	253%	236%
BE	80%	112%	54%	82%	77%
BG	144%	177%	129%	151%	138%
CY	0%	0%	0%	0%	0%
CZ	205%	107%	234%	223%	188%
DK	-22%	-23%	-19%	-22%	-22%
EE	163%	224%	102%	168%	158%
FI	57%	79%	38%	59%	55%
FR	91%	128%	61%	94%	88%
DE	-194%	-344%	40%	-192%	-197%
EL	570%	882%	243%	578%	563%
HU	440%	639%	207%	453%	428%
IE	159%	178%	176%	163%	155%
IT	700%	1132%	150%	710%	691%
LV	151%	207%	111%	151%	151%
LT	162%	187%	152%	170%	155%
LU	72%	94%	44%	79%	64%
MT	81%	115%	54%	84%	79%
NL	0%	0%	0%	0%	0%
PL	245%	350%	165%	252%	237%
PT	-10%	-13%	-7%	-11%	-9%
RO	315%	423%	214%	334%	297%
SK	234%	362%	63%	236%	231%
SI	222%	328%	116%	229%	215%
ES	71%	104%	45%	74%	69%
SE	0%	0%	0%	0%	0%
UK	212%	314%	133%	219%	206%
EU27	140%	202%	84%	144%	135%

Source: Author's analysis

more in comparison to *Baseline* scenario on EU27 level[22], while *Economic stagnation* scenario decreased the impact to IPD from 140% to 84%, i.e. by 56% of GDP less in comparison to baseline scenario[23]. In individual countries, the influence differs and depends largely on impact under baseline scenario, i.e. the larger impact of reforms to IPD under baseline scenario, the more it is influenced by other two scenarios. This Largest differences are in Italy [24] where the difference between baseline and economic growth scenario is 432% of GDP (550% under Economic stagnation).

[22]THis is caused by fact that both initial and final IPD increased because higher prices and wages growth, therefore also the impact was larger.

[23]It is important to mention that change of assumptions in these scenarios influences both initial and final IPD in investigated period, therefore bigger decrease of IPD does not have to mean that the final IPD is smaller in comparison to baseline scenario.

[24]In Italy the impact of pension reforms to IPD was also largest. See previous sections in chapter 5.

Other two scenarios - *Pessimistic* and *Optimistic* have only minor effect on IPD impact. Impact of pension reform of EU27 countries under these two scenarios differs only by ± 5% of GDP which is in comparison to IPD reduction negligible number. This effect is also similar in individual countries. Largest impact was recoded in Romania where it reached ± 19% in comparison to baseline scenario.

As a result, we have found that impact of pension reforms to IPD is almost independent on employment development in the future, but it largely depends on future economic situation of every country.

5.2 Impact of reforms on redistribution

In previous chapter we have tested the impact of pension reforms to IPD. We have shown that the overall sustainability of the pension systems has improved. On the other side, sustainability of pension system goes hand in hand with its generosity. Every sustainability improvement means that the generosity of pension system had to be decreased. In other words, people will have to work longer, pay more, and/or get smaller pensions. We will not describe these changes one by one, but instead of that we will calculate impact on redistribution of money by pension systems as a counter-indicator of IPD. Redistribution can serve us as an indicator showing fairness of the system as opposed to IPD indicating sustainability of the system. It is not goal of this study to investigate redistribution in detail - we have only ambition to capture main changes so that we will see that every sustainability improvement has also its price.

We have estimated redistribution as PV of all future old age pensions at retirement age over FV of all contributions in the pension system at retirement age for a person that is retiring in given year multiplied by 100. The result therefore tells us what percentage of pension contributions an average pensioner will get back in old-age pensions.

Pension system variables determining redistribution in given year are not constant in time. Pension system is changing and the changes are further accelerated by pension reforms. Therefore, we have chosen years 2010 and 2040 as two representative samples where we will investigate redistribution[25]. Redistribution for a person retiring in year 2010 and its evolution based on legislation from years 1993 - 2013 can be found in table 5.7 and redistribution for a person retiring in year 2040 based on mentioned legislation in table 5.8.

[25]We chose years 2010 and 2040, because majority of reforms was focused on relatively nearby years (e.g. pension age in Spain will be increasing by one month a year in time period 2012 - 2018 and by 2 months a year in period 2019 - 2027 until it reaches 67 years) therefore these years will be influenced the most.

Table 5.7: Redistribution of money by pension system in 2010 according to given legislation

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT	102	102	102	102	102	102	102	102	102	102	102	102	95	95	95	95	95	95	95	95	95
BE	117	117	117	117	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
BG	142	142	142	142	142	142	142	101	101	101	101	101	101	101	101	101	101	101	91	91	91
CY	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143
CZ	109	109	109	89	89	89	89	89	89	67	64	64	64	64	64	64	64	64	63	63	63
DK	903	903	903	903	903	903	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057	1057
EE	90	90	90	90	90	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
FI	86	86	86	86	86	86	86	86	86	86	86	86	78	78	78	78	78	78	78	78	78
FR	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179	179
DE	77	77	77	77	77	77	77	77	77	59	59	59	59	59	57	57	57	57	57	57	57
EL	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	83	83	83	75	75	75
HU	82	82	69	69	60	60	60	60	60	60	59	59	59	59	59	59	66	66	66	66	66
IE	436	436	436	436	436	436	436	436	436	436	436	306	306	306	306	306	306	306	306	306	306
IT	71	71	71	71	71	71	71	71	90	90	90	87	87	87	92	92	92	92	92	92	92
LV	112	112	112	118	118	118	118	102	102	102	102	102	102	102	102	102	92	92	92	92	92
LT	187	187	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119	113	113	113	113
LU	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167	133
MT	136	136	136	136	136	136	136	136	136	136	136	136	136	136	135	135	135	135	135	135	135
NL	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61
PL	129	129	129	129	129	129	129	129	129	129	129	210	210	210	210	210	148	148	148	148	148
PT	97	97	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101	101
RO	129	129	139	139	72	72	72	72	72	72	72	72	73	73	73	73	73	73	68	68	68
SK	97	97	97	97	97	97	97	97	97	97	97	100	100	100	100	100	100	100	100	100	100
SI	62	62	62	62	62	62	62	58	58	58	58	58	58	58	58	58	58	58	58	58	58
ES	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104	104
SE	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
UK	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
EU27	151	151	148	148	145	144	150	148	148	147	147	145	144	144	144	144	142	141	140	140	139

Explanation example: a person with average wage and average life expectancy retiring in year 2010 in Austria will get 102% of his pension contributions in pension benefits according to 1993 legislation. However, according to 2013 legislation, he gets back only 95% of his contributions in pensions. Source: Author's analysis

Table 5.8: Redistribution of money by pension system in 2040 according to given legislation

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT	92	92	92	92	92	92	92	92	92	92	92	92	66	66	66	66	66	66	66	66	66
BE	92	92	92	92	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	81	81
BG	120	120	120	120	120	120	120	93	93	93	93	93	93	93	93	93	93	93	71	71	71
CY	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
CZ	71	71	71	59	59	59	59	59	59	60	51	51	51	51	51	51	51	45	36	36	35
DK	989	989	989	989	989	989	1138	1138	1138	1138	1138	1138	1138	989	989	989	989	989	989	989	989
EE	75	75	75	75	75	59	59	59	59	59	59	59	59	59	59	59	59	52	52	52	52
FI	64	64	64	64	64	64	64	64	64	64	64	64	60	60	60	60	60	60	60	60	60
FR	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	97	97	94
DE	62	62	62	62	62	62	62	62	62	62	62	62	62	62	53	53	53	53	53	53	53
EL	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	73	73	73	57	57	50
HU	69	69	59	59	52	52	52	52	52	52	51	51	51	51	51	51	41	41	41	41	41
IE	197	197	197	197	197	197	197	197	197	197	197	143	143	143	143	143	143	143	116	116	116
IT	67	67	67	67	67	67	67	67	65	65	65	60	60	60	62	62	62	49	49	49	49
LV	77	77	77	82	82	82	82	72	72	72	72	72	72	72	72	72	72	72	72	59	59
LT	79	79	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	40	40
LU	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	111
MT	95	95	95	95	95	95	95	95	95	95	95	95	95	95	80	80	80	80	80	80	80
NL	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
PL	90	90	90	90	90	90	90	90	90	90	90	150	150	150	150	150	129	129	129	94	94
PT	71	71	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
RO	117	117	123	123	58	58	58	58	58	58	58	58	58	58	58	58	58	58	49	49	49
SK	104	104	104	104	104	104	104	104	104	104	104	85	85	85	85	85	85	85	85	85	85
SI	58	58	58	58	58	58	58	53	53	53	53	53	53	53	53	53	53	53	53	53	43
ES	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	51	51	51
SE	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
UK	77	77	65	65	65	65	65	65	65	65	65	65	65	57	57	57	57	57	57	57	57
EU27	122	122	121	121	118	117	123	121	121	121	121	120	119	113	113	112	111	110	106	103	102

Explanation example: a person with average wage and average life expectancy retiring in year 2040 in Austria will get 92% of his pension contributions in pension benefits according to 1993 legislation. However, according to 2013 legislation, he gets back only 66% of his contributions in pensions. Source: Author's analysis

Firstly, we will have a look at the redistribution in year 2010. We can see that based on legislation in year 1993 15 countries were giving to their pensioners more money then they contributed in pension system. Denmark is noticeable outlier in group of these countries. Its redistribution of 903 means that government gave to pensioners retiring in year 2010 nine-times more money in old-age pensions than they contributed in system in form of contributions from wages. This is caused by fact that in Denmark contributions from wages are only minimal and majority of pensions is paid from taxes. Further, we can see the impact of pension reforms in this table. In year 2013, only 12 countries are giving to its pensioners more money in pension than they contributed. On aggregate level, the redistribution decreased by 12 points. Moreover, if we exclude Denmark from the calculation because of biasing this statistic, redistribution decreases by 18 points. On the other side, in five countries the redistribution has increased (Denmark, Italy, Poland, Portugal, Slovakia).

Money redistribution in year 2040 is affected even more since process of implementation of many reforms ended after year 2010. Number of countries giving pensioners more money than they contributed decreased from 15 to 8 based on 1993 legislation and from 12 to 4 based on 2013 legislation. The aggregate redistribution also decreased by 20. Also number of countries where redistribution increased changed from five to only two (Portugal, Poland).

Also, the redistribution between genders has changed. It is natural that females live longer than males, therefore redistribution of money for males should be higher than for males. Next important factor influencing the redistribution proportion between genders is pension age. In past 20 years, big changes happened here, since pension age was often equalized for males and females[26]. Bellow in table 5.9 we can see what the impact of pension reforms had on redistribution proportion between genders in 2040.

From the results, we can see that money redistribution is really higher for females as previously mentioned. We can also see that redistribution decreased for both genders, however much higher decrease was recorded by females where redistribution in average decreased by 28. The change differs among countries. In Poland and Portugal, females get after reforms even more money in form of old-age pensions than previously, but in majority of countries females get much less in comparison to year 1993.

We have therefore found that redistribution is decreasing in time, in other words pension systems are less generous after pension reforms. Some countries decreased redistribution from high numbers to fairer numbers, but some countries decreased from already unfair numbers before reforms to even worse. It is hard to say specific

[26]For details, see chapter 2)

numbers, as it depends a lot on year in which we investigate redistribution. What can be said, that in majority of countries females get much more money in form of old-age pensions in comparison to males, but this difference is being slowly reduced in time as female pension age is decreasing much faster.

Table 5.9: Comparison of impact on redistribution in 2040 based on genders

	1993		**2013**		**1993 - 2013**	
	M	**F**	**M**	**F**	**M**	**F**
AT	81	104	62	70	-18	-34
BE	83	101	76	85	-7	-16
BG	97	144	62	80	-35	-64
CY	112	134	112	134	0	0
CZ	59	84	33	37	-26	-47
DK	933	1043	933	1043	0	0
EE	59	91	47	56	-11	-35
FI	60	67	57	63	-4	-4
FR	104	116	88	99	-16	-17
DE	59	66	50	56	-9	-10
EL	73	114	47	52	-25	-61
HU	56	83	38	44	-18	-39
IE	185	208	107	126	-78	-82
IT	54	80	45	52	-9	-28
LV	61	93	53	63	-7	-30
LT	51	110	36	44	-15	-65
LU	137	141	109	113	-27	-28
MT	87	102	73	87	-14	-15
NL	60	67	60	67	0	0
PL	84	95	84	103	-1	8
PT	66	75	69	78	2	3
RO	95	140	49	49	-46	-91
SK	90	118	80	91	-10	-27
SI	47	70	41	46	-6	-24
ES	54	61	47	54	-7	-7
SE	53	61	53	61	0	0
UK	62	93	54	60	-8	-33
EU27	110	135	95	108	-15	-28

Source: Author's analysis

Chapter 6

Conclusion

In this paper we have investigated impact of pension reforms on implicit pension debt in EU27 countries in period 1993 - 2013. We have used methodology introduced by Holzmann *et al.* (2004) to capture impact of all pension reforms. The biggest advantage of this study is that we use unified calculation of IPD for all countries and use consistent data which enables us to estimate comparable results for price of omitting less important features of pension systems. Primary outcome of the model was that majority of countries decreased IPD in the examined time period.

Firstly, we have analyzed pension systems in individual countries. We have described general functions of three pillars and structure of pension systems in individual countries. Further, we have described main schemes and pension system expenditures.

Subsequently, we have investigated what challenges these pension systems are facing. From the factors influencing pension expenditures, especially aging population, represented by increasing dependency ratio, will be testing sustainability of the pension systems as it more than doubles in some countries. The increase will be largest in Central European countries.

Governments know this as the expenditures on pension system are increasing and therefore they are implementing pension reforms to improve its sustainability. Most importantly, governments are implementing reforms in first pillar as it is the main source of growing expenditures, but there were also numerous changes in the second and third pillar. In the first pillar mostly parametric reforms were made to decrease its financial demands. The most frequently used component in these reforms was increasing pension age which was reformed 42 times in the EU27 countries in the investigated period. Increasing age for early pension was also very popular, but it was implemented less in comparison to increasing pension age. These changes further include also change of indexation, increasing contribution rate and modifying replacement rates.

We have found out that these reforms had large impact on IPD in individual countries. In Germany, Portugal and Denmark, the IPD has increased by 10% - 194% of GDP, but in 21 countries, that performed pension reforms, the IPD has decreased. The range of decrease varies from 57% in Finland to 700% of GDP in Italy. Impact largely depends on pension reform components that were implemented.

We found that increasing retirement age has largest impact on IPD, as increase of retirement age by one year decreases IPD by 46% of GDP on average. Reforms of indexation have also significant impact on IPD. However, as the indexation is linked to chosen variables (mostly wages, prices, or its combination), to decrease IPD it is only possible to change indexation linkage from wages growth to price growth, because historically it grows slower in comparison to wages. Increases of early retirement age has smaller impact on EU27 level, as it is not implemented in all countries and usually early retirement is not utilized by whole population. Increasing early retirement age by one year reduced IPD by 21% of GDP on average. This equals to impact of increasing contribution rate by 1 p.p. The smallest impact from investigated components was recorded by decreasing replacement rate by 1 p.p. which reduced IPD by 16% of GDP on EU27 level.

We have found that impact of pension reforms also depends on economic development in individual countries. We modeled scenarios of economic growth and economic stagnation and we found out that impact of pension reforms under these scenarios differs by approximately $\pm$ 60% of GDP from the baseline scenario. On the other side we have found that impact of pension reforms would be only marginally influenced by change of employment rate.

Finally, we have observed that individual countries were able to dramatically increase sustainability of its pension systems. However, sustainability of pension system goes hand in hand with its generosity. We therefore made short research on change of redistribution in investigated time period. As redistribution differs on chosen legislation year after year, we investigated only redistribution evolution in two representative years 2010 and 2040 - 2010 as initial state and 2040 as year that covers all implemented reforms. People retiring in year 2010 get pension by 12% of total contributions smaller according to 2013 legislation in comparison to 1993 legislation. In 2040, this difference made already 20% of contributions.

We have therefore found out that the implicit pension debts can be effectively reduced. Unfortunately, it is not possible to make reforms till infinity, as space for possible pension reforms is shrinking with every reform. Therefore, large pension expenditures will be significant parts of governments' budgets also in the future.

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Appendix A

Data sources

General sources

- Population projections EUROPOP 2013
- EU Ageing report 2012
- International Social Security Association Observatory: ISSA Social Security Country Profiles, available at

  http://www.issa.int/Observatory/Country- Profiles/Regions/Europe/
- ASISP reports http://socialprotection.eu/
- International Labor Office - KILM Database
- EU Mutual Information System on Social Protection database, available at http://www.ec.europa.eu/missoc
- OANDA average exchange rates, available at http://www.oanda.com/currency/average
- OECD pensions at glance 2013, available at

  http://www.oecd.org/pensions/public-pensions/OECDPensionsAtAGlance2013.pdf
- EUROSTAT, available at http://ec.europa.eu/eurostat
- OECD Statistical Database, available at http://stats.oecd.org
- OECD Global Pension Statistics, available at

  http://stats.oecd.org/Index.aspx?DatasetCode=PNNI_NEW
- National statistical offices

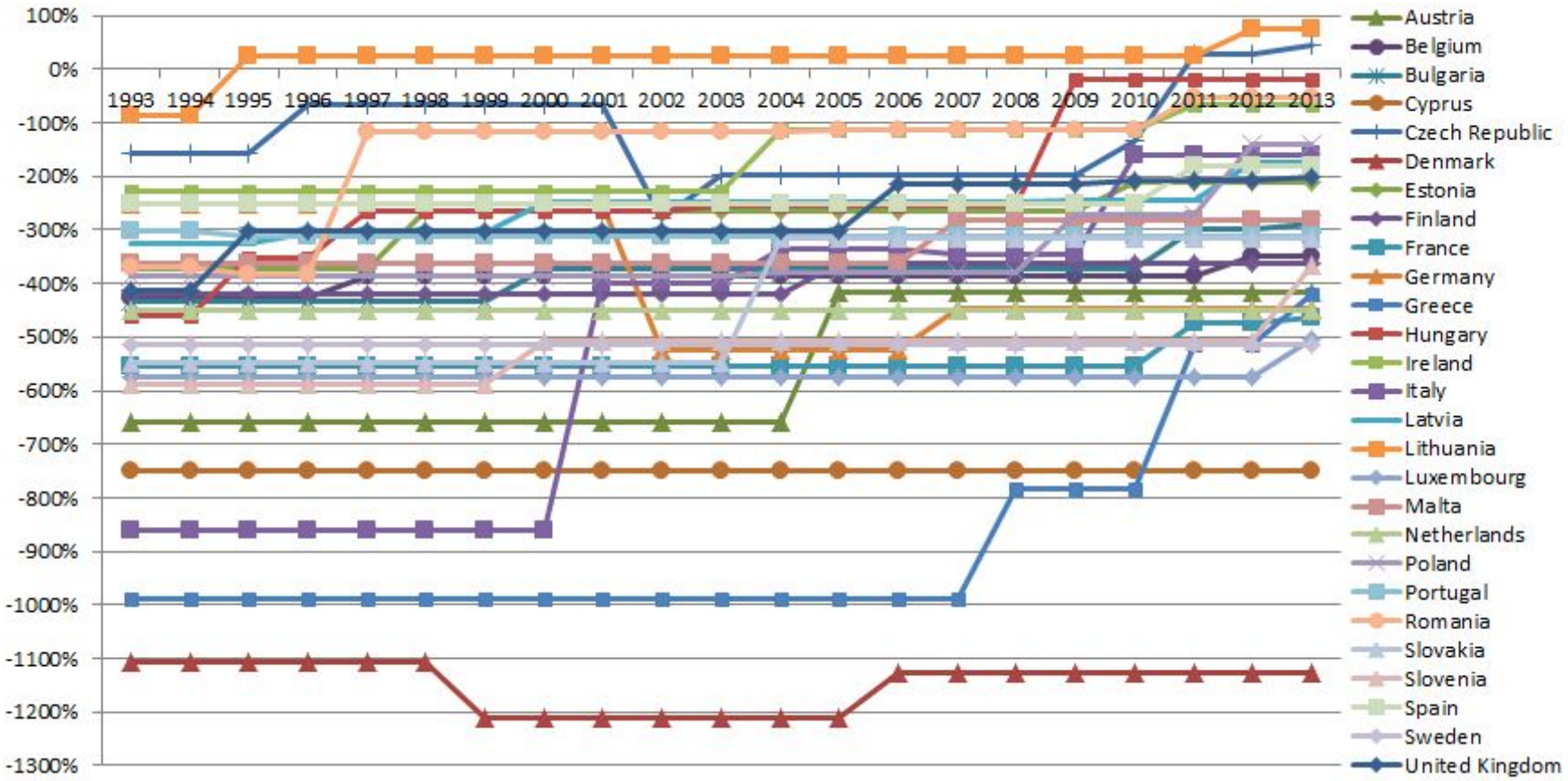
Sources of applied data

- EUROPOP 2013 - Population prognoses
- EU Ageing report 2012 - Projection of life expectancy at 65 years, labour employment rate by age and gender, effective exit age by gender
- International Labour Office - Average annual wages by country and year in local currencies
- EUROSTAT - GDP figures in individual countries in EUR in 2010
- ISSA - Countries pension system legislation and pension reforms description
- ASISP Country reports - Countries pension system legislation
- OECD Pension at glance 2013 - Replacement rates by year and country

Appendix B

Graphs not presented in paper

Figure B.1: Evolution of IPD in individual countries



Source: Author's computation